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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

JANUARY 4.

Institute of Metals (Birmingham Section):—Meeting at the James Watt Memorial Institute at 7 p.m. "Nickel and Nickel Alloys," Paper by W. R. Barclay.

JANUARY 9.

Institute of Marine Engineers:—Meeting in London at 6 p.m. "Modern Steels for Marine Engineering," Paper by T. H. Burnham.

Institute of Metals (North-East Coast Local Section):—Meeting at Armstrong College, Newcastle, at 7.30 p.m. "Welding," Paper by a representative of Messrs. Metropolitan-Vickers Electrical Company, Limited.

Institute of British Foundrymen.

JANUARY 3.

London Branch:—Meeting at Charing Cross Hotel, London, at 8 p.m. "Commercial Moulding-Sand Control for the Modern Ironfounder," Paper by F. Hudson.

JANUARY 6.

Lancashire Branch:—Meeting at Engineers' Club, Manchester, at 4 p.m. "The Patternmakers' Foundry Screw," Paper by F. C. Edwards.

Wales and Monmouth Branch:—Meeting at the Technical College, Newport, at 6.30 p.m. "Bronze Castings," Paper by E. J. L. Howard.

JANUARY 9

Lancashire Branch (Burnley Section):—Meeting at 7.15 p.m. "Blast-Furnace Practice and Notes on the Making of Irons." (Lecturer to be announced later.)

JANUARY 10.

London Branch:—Meeting at Charing Cross Hotel, London, at 8 p.m. Joint meeting with the Electro Depositors' Technical Society.

Lancashire Branch (Preston Section):—Meeting at 7.30 p.m. "Mechanisation in the Foundry," Paper by G. E. France. (Illustrated by cinematograph film.)

Corners in Castings.

Metallurgists and founders will be interested by a short, but interesting, article in a metallurgical contemporary by Mr. J. G. Pearce on the corner effect in castings. Everybody knows that text-books on metallurgy, founding, and the strength of materials, almost without exception, point out the undesirability of sharp corners in castings, and usually give as the reason the fact that during solidification the crystals orient themselves at right-angles to the mould face. At a sharp corner the two lines of crystals meet in a diagonal through the corner, which is thereby supposed to become a plane of weakness. The historical origin of this apparently arose from the failure of a hydraulic cylinder designed and installed by Stephenson for the raising of the tubes of the Britannia bridge across the straits between the mainland and Anglesey. One of these cylinders apparently fractured in service in the way described above, and a replacement casting with the familiar hemispherical end apparently worked without trouble.

This was, however, many years before the microscope was applied to the study of metals, and Mr. Pearce states that experience of the microscopic examination of castings shows that the supposed line at right-angles to the mould face, that is, the face of the casting, is very seldom observed, and sometimes does not exist at all. This, of course, refers to grey cast iron, although, as is pointed out, the above fact may apply in a measure to cast steels, malleable and other irons cast in the white state, and certain non-ferrous alloys. It is, in fact, not only suggested that there is in the ordinary sense of the term no plane of weakness across the corners, but that, in point of fact, a casting embodying sharp corners seldom fails through the corners, and that traces of weakness are seldom observed in such corners.

Some experimental castings bore out these considerations, and we hope that text-book writers will in future refrain from perpetuating this fallacy. The reasons for avoiding sharp corners and sudden changes in sections of castings remain perfectly sound, but the causes hitherto ascribed to them are erroneous. The enclosing of an angle of sand communicates a "hot shot," which retards cooling at the spot already destined by nature to cool last.

Community of Interests and Individualism.

Many foundry owners are torn between two thoughts, which, loosely interpreted, are:—Shall I conduct my foundry in my own way, unfettered by agreements to sell at fixed prices or to pay scheduled scales of wages; or shall I join the appropriate employers' federation and sink my identity somewhat in the restrictions which will be imposed upon me?

These individualists are usually very fine types of men, but they invariably disclose one weakness, and that is a refusal to recognise that the activities of the federated firms directly benefit them. When, not so very long ago, a large section of the foundry industry was working at a loss and struggling by agreement with their fellows to put an end to uneconomic production by co-operation, one foundryowner refused to participate, as he insisted that he worked to a proper costing system and his selling prices were invariably economic. Fortunately, the section was organised and prices were raised to an economic level. The individualist promptly raised his prices to within 5 or 10 per cent. of the official scale. He still refuses to grant that his competitors by their co-operative action had done him a good turn.

We are nearly at the end of the year, and with the dawn of 1934 much fresh evidence of a general community of interests between all ferrous foundries is likely to be revealed. We throw out the suggestion that it would be a wise action for those foundries not attached to a foundry employers' association to take steps to join. Employers' associations have to sell membership like any commercial organisation, and never have there been better prospects of a good return for money. The buyer's selfish paradise is happily being rapidly broadened by according some space therein to the seller, to the great benefit of the whole community. "Trust your competitor more than your customer" would make a good motto for the New Year, as the latter has exploited industry far too long.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Quantity Production and Steel Castings.

To the Editor of The Foundry Trade Journal.

Sir,—Whilst reading the remarks of Mr. C. D. Pollard, made on the occasion of his retiring from the presidential chair of the Sheffield Branch of the Institute of British Foundrymen, I noted one statement which referred to the "mass-produced castings of America." The term "mass produced" has entirely outgrown its usefulness, if it ever had any, and should be replaced by the term "repetition produced." It carries with it a distinctly derogatory influence, an inference which is not soundly or justifiably based.

Do you not think that it is about time that we did a little serious thinking about the true values of repetition production in industry, and more particularly in our own industry? At the risk of being considered dogmatic, I am going to make the statement that repetition castings, wherever made, represent the best of their particular class of material. The reasons for this are extremely easy to see: better pattern equipment, accurate flasks, standardised pouring and gating methods, standardised risers and a preconsidered and thoroughly-tested method of production. This surely constitutes what we as steel founders would like to be able to apply to the whole of our product, but, very unfortunately, the quantities involved forbid us from doing so, excepting in the case of the slightingly-termed "mass-produced" article.

I fancy Mr. Pollard's remarks arose from a scrutiny of a description of Capt. Shane's visit to Europe as an emissary of the United States Navy Department. Assuming that I am correct in this assumption, then surely Mr. Pollard has misunderstood the situation which called forth this visit and the resultant report of it. Like the British Admiralty, the United States Navy Department is obviously interested in ship castings. It buys, from the lowest bidder, in small quantities, numerically, which never could lend themselves to mass production or repetition production. No one realises better than Mr. Pollard that the average ship casting is a one-off proposition, with all the gambling and hazards of such a proposition. The degree of success with which a foundry handles such jobs is usually in direct proportion to the length of time it has been operating on a similar class of work, and the number of similar jobs it has handled. In other words, the nearer one gets to repetition, the nearer one gets to success.

Countless cases can be adduced to confirm my proposition, that the properly produced repetition product is the better one. As just a few examples, American motor cars, with all the diversely oriented kinds of abuse to which the average American driver subjects them, are almost uncanny in their reliability. They are expected to stand any type of treatment in any type of weather, and, more than that, as an article, they do it. Spare parts, when required, always fit, and the accuracy and quality of those parts has many times astonished me. Mass-produced radios, of beautiful quality, are in every home, and get no attention year in and year out, yet give perfect service. Mass-produced refrigerators are in almost every home, and not the slightest unreliability has so far come to my knowledge. Repetition-produced electrical domestic articles are in tremendous demand over here, and yet almost everyone owning them possesses no technical knowledge and consequently submits them to working conditions far from ideal, yet 100 per cent. reliability is demanded of them by the general public; and I would make the claim that the only reason they show this reliability is because they are repetition produced to a standard, and that standard a high one.

In the interest of accurate thinking, therefore, I would suggest to you that we realise that repetion-produced steel castings are the ones on which proofs have been taken, tests have been carried out, and, as the American puts it, "from which the bugs have been removed." Jobbing castings, on the other hand, still carry a considerable hazard, usually accentuated by design, as it is generally on this type of work that the designer gets in his fell activities. It follows logically, therefore, that the nearer we get to repetition conditions the better the product. All of which leads me back to my original suggestion that the term "mass production" should be thrown into the discard, and, along with it, all its derogatory inferences.—Yours, etc.,

Fredk. A. Melmoth.
Vice-President.

The Detroit Steel Casting Company,
Detroit, Michigan, U.S.A.

December 6, 1933.

Foaming Slag Trouble.

To the Editor of The Foundry Trade Journal.

Sir,—In connection with Mr. B. Gale's Paper on "Some Practical Considerations in a Small Jobbing Foundry," and with the letter by Mr. J. L. Francis, I think that the following notes may be of interest:—

Mr. Francis, in the course of his suggestions, expresses the opinion that foaming slag trouble is due to the level of the melting zone being too low, or, in other words, the bed coke has burned away, and his opinion seems to be that the foaming of the slag is caused by the direct action of the blast.

This may be the case, and I have often thought so, but have never been able to reconcile the known facts with the theory. I have never known foaming slag except at the beginning of a blow, when presumably the cupola was comparatively cold, and, generally speaking, it usually occurs when steel is being used with low-silicon irons, although it will occur when mixed with high-silicon irons at the beginning of a blow, but not so badly.

My experience is that on cupolas susceptible to these troubles there is no difficulty in making heavy steel additions after the cupola has thoroughly heated up.

I have also had foaming slag trouble at the beginning of the blow with certain low-silicon refined irons. The troubles have occurred with two different cupolas, one operated by a blower and the other by a fan, and at all conditions of blast from 8 to 16 ozs.

Coke has been the best Welsh throughout, and this at any rate is above suspicion. The quantity of coke used has been varied in such a way that carbon deficiency has been eliminated.

Strangely enough, I have not been able to associate defective castings with foaming slags, the temperature of the metal does not seem to be greatly affected.

The only definite thing I have is that trouble is generally associated with a cold cupola, but beyond that I have no definite evidence, nor have I ever met anybody who could make a satisfactory explanation.—Yours, etc.,

H. E. King.

Bloomsgrove Works,
Nottingham.

December 15, 1933.

History of Iron and Steel.—Volume 11 of the Newcomen Society contains a Paper by F. Bland on the work of John Curr (1756-1823), who was the first to employ cast-iron rails on colliery railways. These rails were angle-shaped with an inside groove, and were laid on wooden sleepers enabling a horse to draw 2½ to 3 tons of coal in 9 to 10 coal trucks.

Random Shots.

I met a man in the train only yesterday who is a collector—a keen, enthusiastic collector. His enthusiasm led him to expound his hobby at great length, but I noticed that his exposition quickly became a defence of his hobby. Probably he attributed my unresponsiveness to doubts of his sanity—if so, he was quite right. He was a modest collector. Not for him the private ecstasy of stolen Rembrandts or the miserly glee of fabulously valuable gems. He was merely one of the millions of cigarette coupon fiends. After all there was some small reason in his collecting as he proudly pointed out. He could, at least, exchange the coupons for goods. In fact, he explained, it was this very feature of his hobby that proved most attractive. He had delightedly discovered that by exchanging his coupons for artificial silk stockings he was able, at one and the same time, to ease the enormous financial burden which the purchase of these nowadays necessary articles of feminine adornment had added to an already overburdened pocket, as well as to maintain a store of acceptable domestic peace offerings of whose timely aid he was, apparently, often in need.

* * *

The majority of collectors cannot claim that their hobbies possess even these humble, though nevertheless praiseworthy, advantages. I know an engineer of great intellect, of acknowledged position, of charm and rare cultural attainments, but, by the bones of the Loch Ness monster! don't mention Philately to him. Once, in his presence, I stamped my feet to restore warmth to my toes, as we were standing in his works. Just that slight incentive sent him raving, glassy eyed, to his office dragging me, reluctant and protesting, behind him to exhibit to me his latest purchase—a piece of dirty, coloured paper at a cost of about £20 to the square inch.

* * *

I know a draper who collects butterflies, and a doctor who is crazy about birds' eggs. I used to have a bosom friend, a metallurgist, who collected, and still collects, I suppose, coins—not money, that would be *too* sensible—but "old and battered bits of metal." That's what his wife calls them, though he describes his hobby as numismatics. I ceased to possess his friendship, though I still retain his wife's, when I tactlessly suggested he stopped coin collecting and started again with manhole covers, or bucket handles, as that, at least, would be good for trade.

* * *

But, believe it or not, I have at last met the grandfather of all collectors, and, of all people, he is an ironfounder. I walked through his foundry with him this morning. He drew my attention to some pieces of pig being used as weights on some nearby moulds, and as I turned towards him to confirm his remarks I saw the tell-tale glassy stare in his eyes, and instinctively braced myself for the fierce grip on my arm that surely followed, and stumbled along in the wake of his hurried stride. It was not to his office he led me, however. His collection was housed in the stockyard and comprised 75 *different brands of pig-iron*. With that face, suffused with its collector's unholy glee, haunting me, I am offering a prayer for the speedy and successful fruition of Professor Andrew's founding course.

* * *

By the way, I'm only three cards off twelve complete packs, and my wife so needs the card table—therefore three jokers would be gratefully accepted by

Marksman.

Commercial Moulding Sand Control for the Modern Ironfounder.*

By F. Hudson.

Commercial moulding sand control, properly applied, should be looked upon as a sound investment by every founder. Obtaining the highest degree of control will probably depend principally upon the consideration of two factors—firstly, the suitability of the sand-handling and preparation equipment available, and, secondly, upon the initiation of a suitable scheme of sand-testing methods. The question cannot be answered by any statement of broad principals, as it also involves discovering by observation and experiment the properties of sand most satisfactory for the type of castings being made and the moulding methods in use.

The determination of proper characteristics, furthermore, is not an easy matter. There are so many variables involved that definite conclusions can only be drawn after every factor has been taken into account and when averages are taken over long periods. Consequently it is not intended that this Paper should outline generalities or theories upon the subject, but rather to describe a concrete example of the application of sand control in a modern foundry. Accordingly, it is proposed to divide the Paper into two sections, the first part dealing with the installation of suitable plant and control methods, and the second part dealing with the problems that are likely to arise and the final benefits gained. Perhaps in the first case it may be as well to state that all following remarks refer to the manufacture of high-class engineering castings, such as valve bodies for the control of all classes of fluids, their accessories such as headstocks and other operating mechanisms, hydrants, sluice gates and pumps as specialised in by Messrs. Glenfield & Kennedy, Limited.

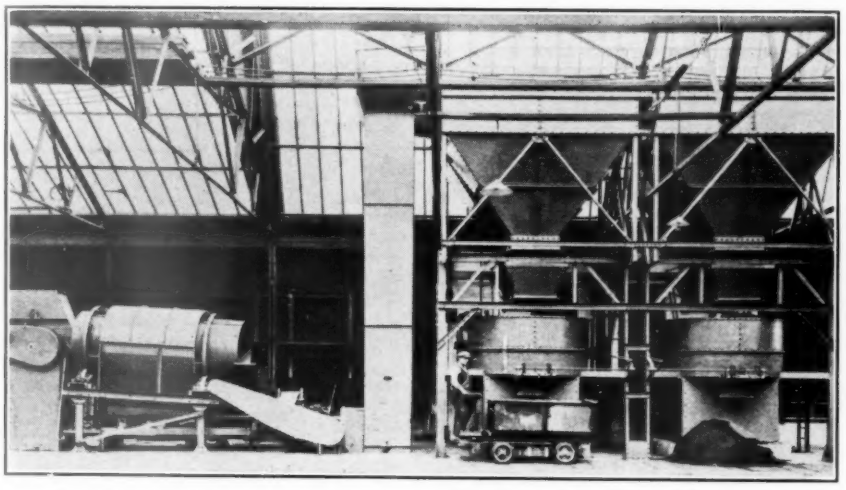

FIG. 1.—GENERAL VIEW OF SAND PLANT INSTALLED AT MESSRS. GLENFIELD & KENNEDY, LIMITED.

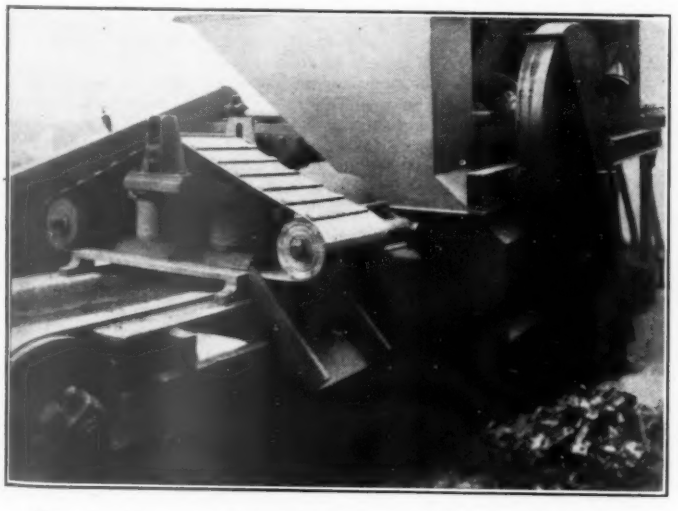

FIG. 2.—MAGNETIC SEPARATOR INCORPORATED IN THE SAND PLANT SHOWN IN FIG. 1.

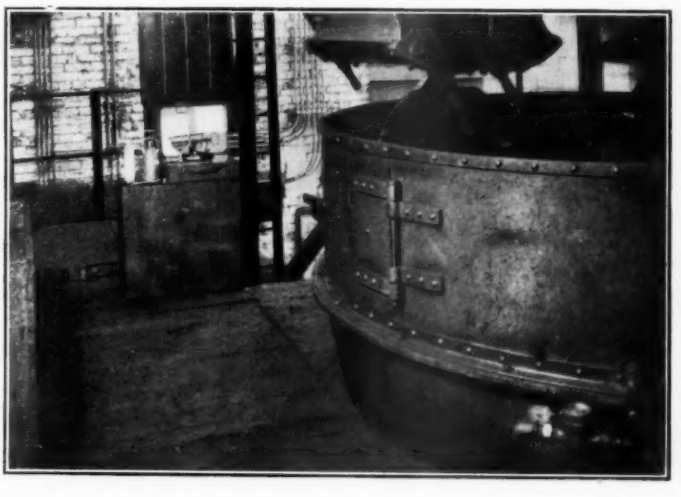

FIG. 3.—VIEW OF THE WORKING PLATFORM, SHOWING THE "SPEEDY" MOISTURE TESTER AND MOISTURE-CONTROL BOARD.

* A Paper read before the Manchester Branch of the Institute of British Foundrymen.

PART I.

Plant and Control Methods.

Previous to the installation of sand control it was customary to employ both facing and backing sands. The facing for green-sand work was made up from approximately:—57.1 old floor sand, 21.4 new rock sand, 14.3 red sand, and 7.2 per cent. coal dust. This was mixed by hand and then put through a Herbert aerating machine, nicknamed the "Joy Wheel," and delivered to the moulder. The moulder was responsible for the preparation of backing sand, which consisted of old green-sand floor sand, plus the addition of rock sand, according to discretion and the type of casting being made. This duty was conducted at the end of each day's cast, after the moulds had been "knocked out," the sand being tempered, mixed by hand and then put through a portable Royer aerating machine.

Accordingly it will be observed that the moulder, as well as making moulds, had to strip his own castings and prepare, and be responsible for, the bulk of his sand.

Conditions in regard to the preparation of dry sand were also far from satisfactory. Similar to green-sand practice, both facing and backing sands were used, the sand being prepared in an old type of pug mill, a piece of equipment most suitable for crushing bricks but far from being satisfactory as a means of preparing moulding sand. Consequently consistent supplies of sand were like ideals in a dream and reality demanded recourse to a variable mixture according to the views of the foreman in charge and the size of castings being made. Roughly speaking, the facing mixture would be along the following lines:—1 barrow dry-sand floor sand; ¾ barrow rock sand; 3 shovels loam, and 2½ shovels ashes.

Happily, however, the management had been giving consideration to the question of sand control for some time, and it was decided to go ahead with the installation of a centralised sand-preparation and distributing plant with the view of bringing the foundries up to date as demanded by present economic conditions. By taking this step it was felt that it would allow the green-sand moulder to produce a greater output of castings, as all this time could then be utilised for moulding purposes instead of part being occupied for sand preparation. Furthermore, it was considered that a centralised plant would most readily lend itself to a scheme of control whereby sand could be produced at lowest cost having those properties best suited to safe casting production. It was also appreciated that in a scheme of this nature it would be advisable to work with the minimum number of sand mixtures possible, the ideal being in the production of a sand that could be used with minor modifications, for both green- and dry-sand purposes.

Broadly speaking, it would appear that in modern foundry practice green-sand moulding is becoming a lost art, particularly where the larger sizes of castings are concerned, yet now

when industry needs this form of moulding most, due to its lower cost, there are few skilled artisans available. Furthermore, present-day mass-production methods militate against the revival of the highly-skilled man, and if the industry is to revive this branch, it would appear to be essential to produce a "foolproof" sand which does not require the individual skill of the trained moulder. In the Glenfield foundries there are many castings made in dry sand which

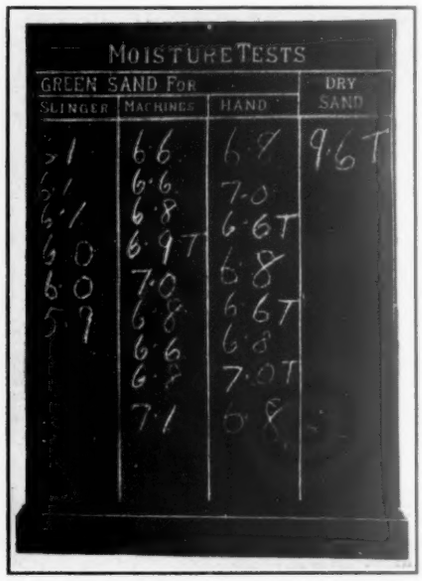

Fig. 4.—Showing Moisture-Control Board at the End of the Day.

one would like to see made in green sand, and in their study leading up to the production of a standard sand—call it a green-dry sand if you like—it was decided that in order to obtain success it would be necessary for the green sand to have the properties of dry sand.

The foregoing remarks give a fair idea of the firm's aims and ambitions leading up to the installation of commercial moulding-sand control.

Sand-Preparation Plant.

Fig. 1 gives a general view of the plant. The operation of the plant, as shown, is for the return sand to be delivered either on to the grating over the boot of the knock-out elevator or direct by means of the underground conveyor which traverses all the moulding bays in the foundry. The elevator delivers the sand into a rotary screening and breaking drum fitted inside with lifting blades which pick up and then drop the lumps, thus breaking them up. The fines pass through wire mesh plates, and the refuse is collected and discharged at the end of the screen.

When the sand falls through the screen it is collected on a flat india-rubber and canvas belt conveyor and then passes under a magnetic separator as shown in Fig. 2. This separator is rather out of the ordinary, as it consists of a dual magnetic system. The magnets are arranged both below and above the main conveyor belt, and the material first comes under the influence of the magnets below the belt. Ferrous material travelling on the belt is thus retarded, and this reduction in speed enables a second set of magnets, placed above the belt, to exert their full attractive force. The iron is extracted, and by means of a cleaning belt is deposited to one side. The sand, which has now been screened and freed from sprigs and iron particles, is elevated to a flat belt conveyor running over four storage hoppers. This conveyor is fitted with adjustable ploughs for directing the sand into the required storage hopper, each having a capacity of about 10 tons.

At the bottom of each storage hopper are fitted double chop gates operated by levers which control the supply of sand into the measuring hoppers fixed immediately below. These measuring hoppers are also fitted with double chop gates, and have 10-cwt. batch capacity discharging into 8-ft. mills. The mills are of the stationary-pan type fitted with renewable wear plates and equipped with two rollers carried on rocker arms to allow of rise and fall for bulky materials. The rollers may be adjusted to run either on the pan bottom or with any clearance required according to the extent of kneading action necessary for the sand being treated. In addition to the rollers there are two sets of beaters, positively driven, as they revolve around the pan as well as the usual ploughs. It will be understood that the positively-driven beaters have an agitating action on the sand and provide a more intense mixing than can be obtained from the ploughs and rollers alone.

Water is added through sprinklers running round the inside of the pan and the quantity controlled by Glenfield rotary water meters. The new sand is measured and added by hand from storage bunkers level with and adjacent to the working platform.

The working capacity of the plant is about 20 tons per hour, and it has been specially designed to work in conjunction with a continuous moulding system which will be a future development of the firm. At present, however, the sand-distribution conveyors required by the completed scheme are not yet installed, and the delivery of sand to the moulders is conducted by means of tipping stillages. The mixing time for a batch of sand is around 3 min., and before it leaves the mill the moisture content is checked by means of the "Speedy moisture tester" and the figure obtained marked up on a special control board for future reference. Fig. 3 illustrates the working platform and the methods adopted for moisture control, and Fig. 4 shows the moisture control board at the end of the day's work. It will be observed that the moisture content is varied according to the

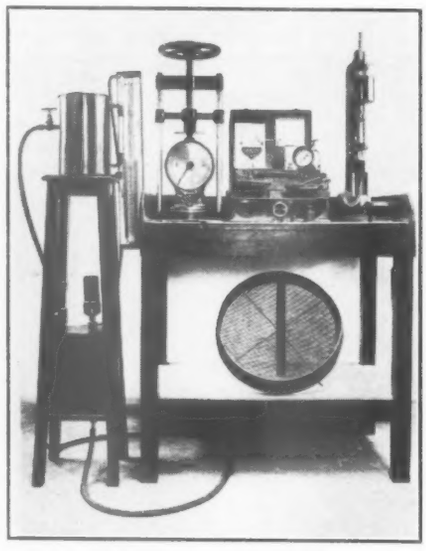

Fig. 4a.—Apparatus required for Green-Sand Control, which includes Sieve, "Speedy" Moisture Tester, Balance and Weights, A.F.A. Ramming Device, Compression-testing Machine and Richardson's Permeability Apparatus.

purpose for which the sand is used and the type of machine it is to supply. Every batch of sand mixed is not tested on the "Speedy" tester, as it is considered unnecessary in view of the added water being metered for each batch. There is no disintegrator or aerator fitted to the plant.

Test Methods Used for Sand Control.

A good deal of thought was devoted to this problem, and after trials covering the best part of a year with all available equipment, it was decided to standardise principally on those methods recommended by the American Foundrymen's Association as covered in the Report of the Sub-Committee on Sands and Refractories given at the last Convention. The main points responsible for the decision being

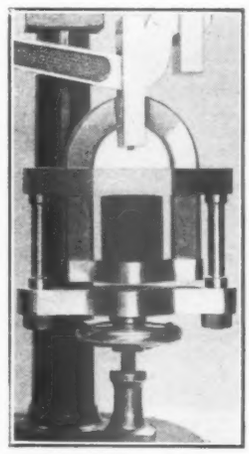

Fig. 5.—Compression Link fitted to Standard Cement-testing Machine for obtaining Dried Compression Strength of Moulding Sands.

made in this direction are as follow:—(1) The methods are applicable for testing sands having widely-different properties; (2) test results are rapidly obtained and representative of practical conditions, whilst not being affected by minor test inaccuracies; (3) results are directly comparable with the bulk of reference work available; and (4) the equipment is simple and robust in operation and is capable of being used by the average practical worker.

After the testing equipment had been selected the routine control tests proper were put into the hands of a laboratory assistant and work commenced. An example of the schedule adopted, say for the control of green sand, can be outlined as follows:—

The operator on the sand plant takes a sample of the sand as it leaves the mill and puts it through an ¼-in. mesh sieve and then into a canvas sampling bag, and immediately despatches it to the sand laboratory. He also takes particular care to see that the main sand batch has been tested for moisture on the "Speedy" apparatus. As soon as the sample reaches the laboratory, a small portion of it is weighed out and put into an electric oven at 105 deg. C. to determine the true moisture content and to check the mill operator and his more rapid methods. The sand chemist then rams up any test-pieces required for determining the dried strength of the sand, puts these into the oven and, when this is completed, determines the green compressive strength and permeability on the remainder of the sample. The actual methods employed and the apparatus required are fully described elsewhere, so it is not proposed to spend much time on this aspect, but the sequence of thought certainly demands a brief outline in this direction.

Compressive Strength.

Exactly 151 grammes of green sand are weighed out and introduced into a split cylindrical metal corebox, which is set into position on the ramming device, as shown in Fig. 4a. The sand is then rammed by energy obtained

(*Continued on page* 360.)

The Institute of British Foundrymen.

LONDON BRANCH ANNUAL DINNER.

The Annual Dinner of the London Branch of the Institute, held at Charing Cross Hotel on Wednesday, December 13, was a function upon which Mr. C. H. Kain (the Branch-President), Mr. H. W. Lockwood (the hon. secretary) and all others concerned are to be congratulated. The number present was well above the average, and the company included Viscount Lymington, M.P., Mr. C. E. Williams (President of the Institute), Mr. Roy Stubbs (Senior Vice-President of the Institute), Major F. A. Freeth, F.R.S. (President of the British Cast Iron Research Association), Mr. K. Headlam-Morley (secretary, Iron and Steel Institute), Mr. A. S. Beech (Senior Vice-President of the Branch), Mr. Barrington Hooper, C.B.E., Mr. Wesley Lambert, C.B.E., and Mr. V. C. Faulkner (both Past-Presidents of the Institute and of the London Branch), Mr. W. B. Lake (hon. treasurer of the Institute and Past-President of the London Branch), Mr. J. W. Gardom (Past-President of the Branch), Mr. R. H. Brackenbury (President, Foundry Trades Equipment Association), Mr. W. T. Griffiths and Mr. S. L. Archbutt (of the Institute of Metals), Mr. A. Young, Mr. J. C. Green, and Mr. T. Makemson (general secretary).

Mr. Gardom performed, with great success, the duties of toastmaster.

Novelty Menus.

A feature of the annual dinners of the London Branch has been the attractiveness of the programme and menu card. This year, however, the Branch-President was responsible for a very novel feature. Each member of the company received a perfect reproduction of an oyster shell made of cast iron, with a hinge at the top, and inside the shell there was a folded strip on which were set out the menu, the toast list and the names of the artistes who provided the entertainment. They were Mr. Ronald Frankau (entertainer), Mr. John Lovering (baritone) and Mr. Monte Crick (accompanist).

During the dinner a jar of spriggs formed the subject of a guessing competition. Prizes, consisting of a bridge set and desk reference libraries of seven volumes, were given by Mr. Barrington Hooper. Mr. Gray was the winner, guessing the exact number (412). The second and third prize winners were within one and three respectively of this figure.

Agriculture and Industry.

The loyal toast having been honoured, VISCOUNT LYMINGTON, M.P., proposed "The Institute of British Foundrymen," and said he was honoured to have the opportunity of doing so, one reason being that he was a personal friend of Mr. Kain. In the first place, however, he could not resist a comment upon the oysters which had been presented to the company, and which, he was informed, had been cast by Mr. Kain; one was not quite sure whether they were intended to give a hint to speakers to shut up like an oyster, or whether they were to be symbolic of the pearls that fell from the speakers' lips.

Being a farmer by trade, by inclination and by habit, and though he used the products of the foundry on his land, he could not pretend to know anything of the technical part of the foundrymen's work; his only personal connection with an iron foundry was that he was able to shoe a horse cold.

Lord Lymington went on to discuss the agricultural industry and the foundry and other industries in their relation to the nation's affairs. It had always seemed to him that the mistake made by the last generation, and, indeed, the mistake of the last century, had been to exploit economics at the expense of politics. He believed intensely, whatever political creed one might adhere to, that the main object of a nation must come before the individual economics which anyone of us might practice. We had always been told that our export trade was absolutely vital to the health of the nation, that upon it alone could we depend, and, therefore, that we had to import on every occasion the cheapest products of the world, in order that we should be able to export. As a result of that, there had been in the past a total unbalancing of the nation in its fundamental economic health, as well as its physical and its spiritual health and character. After all, the agricultural and the foundry industries were vital to each other. The foundrymen could not live without food, and the agriculturists could not produce without the assistance of the products of the foundry. If the foundrymen were going to say that they could only win their living by selling to the people abroad who obtained their living from the service of the industry, then we were going to be always in a desperately dangerous position, at the mercy of the outside world, and at the mercy of the navies of other people if our own country were not properly defended; and there was no doubt in his mind that we were not properly defended. Equally, there was no doubt in his mind that the other countries of the world were not going to be altruistic in dealing with the peoples of this country. Therefore, we must look to the interrelation of our industries and the natural wealth which lay within these islands and within such areas of the world as we could control. If he, as a farmer, knew that those responsible for the government of this country under H.M. the King had a fixed and definite purpose before them, he could order his own work, so that he could employ more workers directly on the land with the hope of permanency and security, and the founders could be producing for a sure market in this country. But to put that forward as a programme by itself must fail unless we in this country determined that quality counted before quantity, and individual excellence of character before mere mass employment.

One further reason why he was proud to have the opportunity to propose the toast of the iron-founding industry was that it was making a new effort to reintroduce the excellence of the apprenticeship system. He did not believe that modern education, which was no more than quantity opposed to quality, was going to solve any single problem unless it got back to personal character, personal and individual leadership, and, above all, technical excellence. We could legislate—generally harmfully—for every single thing except personal character. The leaders of an industry might feel that, whilst a Government, under democracy, might ruin them, it could never supply their wants as they could in the matter of the early education of their apprentices.

"Institute" "British" "Foundrymen."

MR. C. E. WILLIAMS (President of the Institute) responded to the toast and complimented Viscount Lymington upon his statesmanlike address. The Institute of British Foundrymen, he continued, owed much to its London Branch; and the Branch and the Institute owed much to Messrs. Lake & Elliott, of Braintree, for not only had they provided the Institute with its invaluable treasurer (Mr. W. B. Lake), but they had also provided the London Branch with its President and the manufacturer of the marvellous oysters which had been provided on this occasion. The Branch was to be congratulated upon its good fortune in having Mr. Kain as its President, for he was a man who combined keen interest in all foundry matters, a grasp of its technicalities, a delightful charm of manner, and an artistic appreciation of line and colour!

Dealing briefly with the words "Institute," "British" and "Foundrymen" in turn, Mr. Williams first called attention to a brochure entitled "British Foundrymen," published recently by the Institute. In this it was stated "The Institute concentrates on technical science, upon deepening the mental resources of its members. This booklet is published in the hope that all foundrymen, realising the need for greater unity and more mutual loyalty, will join us and strengthen our ranks." One might well paraphase that by saying "The more we are together the happier we shall be." The results of the Institute's research work, through its Technical Sub-Committees, were made available, not only to the members but to the world at large, by publication in THE FOUNDRY TRADE JOURNAL—over which Mr. V. C. Faulkner so ably presided—and in the Institute's booklets, such as that entitled "Typical Microstructures of Cast Iron." An outstanding feature of the Institute's work was that it was absolutely unselfish. How different would the results of the Ottawa Conference and the deliberations of the League of Nations have been if those concerned had approached their problems with the goodwill and unselfishness which was so evident in the Institute's activities!

Coming to the word "British," Mr. Williams recalled that in 1914 we had entered the war because we had respected the "scrap of paper" we had signed, promising our support if Belgium were invaded; and we should bracket that fact in our minds with the freedom extended to all slaves in areas under the British flag 50 years ago. We could remember with pride also Britain's action after the war, when we had proposed that all war debts be cancelled so that all countries could get on with the job of repairing the damage done. It was true that we were over-ruled, and that eventually we had signed the Treaty of Versailles—of which it had been said, "here, indeed, is a peace which passeth all understanding"—but we had, at any rate, suggested a better peace.

As to the "Foundrymen," it was difficult to estimate their value to the whole of the human race. Four or five thousand years ago it was the foundryman who, by uniting the copper of the island of Cyprus with the tin of the island of Britain, had led the world out of the Stone Age into the Bronze Age; and it was within the knowledge of all present that the foundryman, by leading us into the Aluminium Age, had made modern flying possible. On December 17 there would be celebrated the thirtieth anniversary of the first flight in a heavier-than-air flying machine, which flight was made by Orville Wright at a height of 850 ft. and a speed of 35 m.p.h., using a 12-h.p. engine. To-day, however, engines of 2,500 h.p. are used; speeds up to 423 m.p.h. are attained; and modern air liners carry 1½ tons of mails in addition to passengers and cargo. Foundrymen had played their part in the development of flying, and it was to be hoped that flying would be used to enhance brotherliness and good feeling among all the peoples of the earth.

The Guests.

MR. A. S. BEECH (Senior Vice-President of the Branch, proposed "The Guests," to all of whom he extended a cordial welcome. One took off one's hat, he said, to the agricultural industry, with which Viscount Lymington was concerned, for it must be acknowledged as the primary industry in every country in the world. At the same time, it would be in a very sorry plight without the assistance of the foundrymen, who produced the wonderful machines and implements which it needed. The agricultural

industry was closely allied, therefore, to the founding industry, and the Branch extended a warm welcome to so distinguished a representative of agriculture. To say that the members of the Branch were pleased to see Mr. Williams and Mr. Roy Stubbs present on this occasion would be merely to paint the lily; the members were indeed delighted to see them, and they remembered with gratitude the very fine Presidential Address Mr. Williams had delivered at the annual convention of the Institute in Cardiff this year. Another honoured guest was Mr. Barrington Hooper, of whom they were all reminded each Friday morning, when THE FOUNDRY TRADE JOURNAL was received. He and his colleague, Mr. Faulkner, were to be congratulated on the great progress which that Journal had made during the last twelve years, and the success of the London Branch was in large measure due to the work which Mr. Faulkner had done on its behalf. Mr. Beech also paid a tribute to Mr. Headlam-Morley (the Secretary of the Iron and Steel Institute) and to Mr. Tom Makemson (the General Secretary of the Institute of British Foundrymen), who was always the same to everybody, and who was welcomed by every Branch of the Institute. Others to whom Mr. Beech made particular reference were Major Freeth (President of the British Cast Iron Research Association), Mr. S. L. Archbutt (representing the Institute of Metals), Mr. R. H. Brackenbury (President of the Foundry Trades Equipment Association), Mr. A. Young and Mr. J. C. Green (who had presented Papers to the Branch this session), and Mr. T. P. Ellis (to whom the Branch was grateful for his assistance as lanternist).

The name of Mr. Headlam-Morley was coupled with the toast.

Co-operation with Allied Industries.

MR. K. HEADLAM-MORLEY responded to the toast. Searching for a possible reason for having been invited to respond, he said that perhaps it was that this was the first occasion on which he had attended, so that he was something of a novelty or an experiment—and experiment was a tradition of British foundrymen. But experiments were sometimes a little risky! There was a time when foundrymen, even British foundrymen, had not a reputation for liking experiments, and he believed he had heard it whispered that in the past there was an element of conservatism in the craft. But that was before the Institute was founded—and perhaps it was the reason why the Institute was founded. To illustrate his remarks, he recalled that some years ago he had made the acquaintance of the manager of a small foundry in the North of England who had perfected his castings by sprinkling into the molten metal a handful of some mysterious substance, the secret of which he had kept; and he certainly had turned out very good castings. This man was not a member of the Institute. (Laughter.) On the other hand, his assistant was a most progressive young man, who was also a most active member of the local section of the Institute. Probably that was the reason he would advance for the high quality of the castings produced; at least, he had no hesitation in taking the credit—which was perhaps a characteristic of assistant managers! To impartial observers this partnership had appeared to represent a perfect blending of the old-fashioned with modern science. Subsequently, however, the manager had retired, and had taken his secret with him; the former assistant manager had become manager, and the foundry was thoroughly up to date, but Mr. Headlam-Morley was unable to give information as to the quality of the castings now produced there as compared with that of the castings produced formerly.

The older foundrymen had undoubtedly possessed experience and craftsmanship; but those two attributes alone would not be sufficient to meet the demands of modern industry, and they could never have produced the still more wonderful castings which are to-day commonplace in many foundries. So it was that science had to be called in. During the 30 years which had elapsed since the Institute was founded the progress of the art had been vastly greater than during the preceding century, and the Institute was fully justified in claiming full credit for all that great progress. It was known as one of the most active and progressive technical institutes of the country and of the world; it had fostered the knowledge of the craft, it was continually spreading the accumulated knowledge over the whole world, and it was constantly experimenting; and it had done a great deal to make available the wonderful new alloys which had brought about the greatest change in the modern history of metals.

He felt justified in regarding this invitation as a sign of the friendly feeling that had always existed between the Institute of British Foundrymen and the Iron and Steel Institute. They had much in common, and, he was glad to say, a considerably overlapping membership. They studied subjects of mutual interest. The Iron and Steel Institute valued very highly the friendliness and co-operation of the British foundrymen, and he hoped sincerely that their co-operation would not only be maintained, but would be extended. If it were within his power to foster such co-operation, to avoid duplication or competition by joint investigation and collaboration, it would be his sincere endeavour to do so.

Education.

MAJOR F. A. FREETH, F.R.S., was at a disadvantage when he rose to propose a toast to the London Branch and its President, because the hour was so late, but he introduced himself, almost breathlessly, as a chameleon, a so-called geo-chemist of Imperial Chemical Industries, President of the British Cast Iron Research Association "and a lot of other things too." He refrained from discussing soda ash, and made a brief reference only to education. In this connection he said he did not want men to concentrate on applying labels such as "B.Sc." to their names, because in real life they would get a kick in the pants. "Get out a scheme of training if you like," he said, "but for Heaven's sake don't make it formal." If they could get somebody who would really teach, and if the students really admired the teacher, they would be all right. Founding was an art, and science was out to help all it could.

Sound Castings.

The BRANCH-PRESIDENT, responding, expressed his deep gratification that Major Freeth, as President of the British Cast Iron Research Association, had proposed the toast of the London Branch, because we had it on the authority of Mr. Kipling that:—

> "Gold is for the mistress, silver for the maid,
> Copper for the craftsman, cunning at his trade.
> 'Good,' said the Baron, sitting in his hall,
> 'But iron, cold iron, is master of them all.'"

Since many members of the Branch were mere workers in other metals, they should be very honoured in having their health proposed by the Baron himself.

The London Branch, continued the President, was recovering from the tragic loss of two of its most able members and Presidents; for this recovery it was very largely indebted to its admirable secretary, Mr. Lockwood, whose task had been very difficult, and one which could have been carried through successfully only by a man of exceptional ability and organising power. He had been nobly supported by the Branch Council and the Past-Presidents.

The London Branch was carrying on the work of his famous ancestor, Tubal Cain, who was "an instructor of every artificer in brass and iron." Many of the other Branches of the Institute were associated with some special side of the foundry art, but the membership of the London Branch covered the whole range of foundry practice.

Metallurgically, London was usually associated with the Royal Mint and streets paved with gold; but, as the Craft Guilds had their centre in London, it had always possessed an iron and steel industry. More recently, in 1531, we were told that iron might be hardened by quenching "in the blood of a man of thirty years of age and of a sanguine complexion being of a merry nature and pleasant, distilled in the midst of May." So that the present versatility of interest was no new thing.

The foundry industry had been praised considerably (at a joint meeting of the Branch with the London Section of the Institute of Metals during the previous week, and by Mr. Headlam-Morley in his speech) for the progress it had made. But, whilst it was agreed that considerable progress had been made, it must be admitted that the major portion of it was in the direction of metallurgical improvement and economic development. He felt that the foundry art itself, the production of sound castings, had not kept pace with these developments. The recent report of the Iron and Steel Institute on Steel Castings must have shaken foundrymen very much, as their industry was always associated with close technical control.

In a plea for better and better castings, the President urged that here was a glorious opportunity for London. Rather than concern themselves with chemical dialectics and the highly-organised conversion of first-class materials into mass-produced blowholes, let them lead the way in a determined search for better, sounder, more homogeneous castings. With few exceptions the new high-duty high-strength metals and alloys presented difficulties in casting, and these difficulties were increased by the present high production speeds. There could be no doubt that for successful continued service a sound casting of a poorer material was better than an unsound one of a superior metal, for the slightest flaw was a potential cause of failure. Therefore, he pleaded, "make the name of London synonymous with sound castings."

International Congress, 1934.

MR. VINCENT DELPORT, as European representative of the American Foundrymen's Association, extended an invitation to attend the fifth International Foundrymen's Congress in Philadelphia in October, 1934. He recalled that the idea of holding these large-scale international congresses was mooted in this country, for it was at a meeting in Birmingham in 1922 that Mr. Stanley G. Flagg, Mr. H. Cole-Estep, Mr. Oliver Stubbs, Mr. V. C. Faulkner and Mr. Ronceray had laid the foundations of the international congresses and exchange of Papers. The first international congress was held in Paris in 1923, the second in Detroit in 1926, the third in London in 1929, the fourth in Paris in 1932; other international foundrymen's conferences were held in Spain (1928), Belgium (1930), Italy (1931) and Czecho-Slovakia (1933). The American Foundrymen's Association had contributed 34 international exchange Papers to foreign associations, of which 12 had been contributed to the annual conferences of the Institute of British Foundrymen. European associations had contributed 34 to the American Association, of which 12 were contributed by the Institute.

During the first week of the Congress in Philadelphia, in addition to the meetings, there would be opportunities to visit the international exhibition and to see the 'developments in foundry equipment in the United States during the last two or three years. After the first week there would be a conducted tour through the industrial districts of the United States, when many plants and foundries would be visited. He strongly recommended foundrymen to join the party.

Some Experiments on the Heat-Treatment of Malleable Cast Iron.*

By J. E. Hurst (Vice-President, Institute of British Foundrymen).

Experimental work on the effect of heat-treating grey cast irons by hardening and tempering has shown that very distinct improvements in the mechanical properties can be obtained with suitable compositions of material under suitable conditions of heat-treatment. The results obtained with grey cast irons encouraged the extension of these investigations to commercial varieties of malleable cast iron. It has long been known that malleable cast iron when heated to a high temperature and quenched in water acquires intense hardness, and it is probable that heat-treatment by hardening and tempering has been practised for certain specific applications. At the time these experiments were commenced in August, 1931, very little published information was to be found on the effect of various hardening and tempering processes on the physical and mechanical properties of malleable cast irons, and from this point of view the situation is not much different at the present day. It was considered advisable to investigate the effect of heat-treatment, by quenching and tempering, on the mechanical properties of various types of malleable cast iron.

The first experiments were carried out on test-rings obtained from a malleable cast-iron cylinder, approximately 3 in. outside dia. by $\frac{3}{8}$ in. thick, cast by the centrifugal process. The cylinder, 8 in. in length, was cast from a melt of refined white malleable pig-iron melted in a crucible. The hard cylinder was cast by the centrifugal process in a metal mould and was sent to a malleable cast-iron foundry for annealing by the usual white-heart methods. The cylinder after annealing was of the white-heart type and quite freely malleable and machinable. For testing purposes the cylinder was machined inside and outside, thus removing for the most part the outside skin. The machined cylinder was cut up into annular slices, approximately $\frac{1}{4}$ in. square section, and annular rings conforming to the dimensional requirements for testing in accordance with the B.S.I. Specification 5004. For full details of this method of testing, reference may be made to previous Papers† by the author. The annular slices and test-rings were hardened by quenching in oil from various temperatures, and the results obtained are given in the following tables.

TABLE I.—*Brinell Hardness of Centrifugally-Cast White-heart Malleable Cast Iron Annular Slices, ¼ in. Square Section. Before and After Oil Hardening and Tempering.*

No.	Hardness before heat-treatment.		Hardness after quenching in oil from deg. C.				Hardness after tempering hardened specimens at deg. C.			
	Outside.	Inside.	800.	850.	875.	900.	300.	350.	400.	625.
1	179	217	488	—	—	—	—	—	412	235
2	179	187	—	568	—	—	412	435	—	—
3	143	179	—	488	—	—	—	—	328	235
4	163	187	—	—	460	—	435	390	—	—
5	179	187	—	—	460	—	—	—	352	217
6	170	196	—	—	—	518	488	412	—	—
7	179	187	—	—	—	534	—	—	390	352

The hardness-test results on the annular slices set out in Table I were determined approximately in the middle of the radial thickness of the slices. Before oil hardening and tempering the specimens showed some slight variations in hardness between the outside edge and centre. Quenching in oil is accompanied by a marked increase in hardness, values of over 500 Brinell being attained. As would be anticipated on tempering at successively-increasing temperatures the hardness decreases, and hardnesses of just over 200 are obtained with a tempering temperature of 625 deg. C. It is rather curious to note that the specimen hardened by quenching in oil from 900 deg. C. does not appear to undergo so large a drop in hardness after tempering as the specimens hardened at a lower quenching temperature, for on tempering at 625 deg. C. this specimen still shows a hardness of 352.

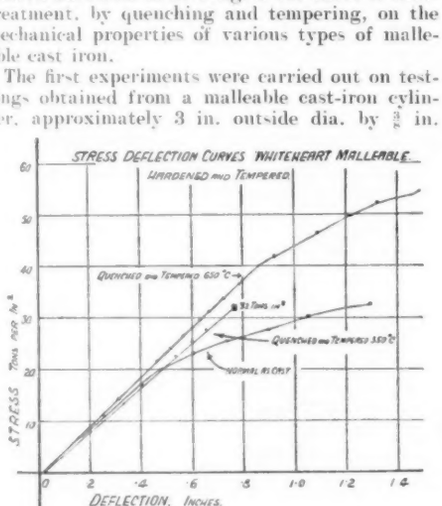

FIG. 1.—STRESS-DEFLECTION CURVES OF WHITE-HEART MALLEABLE.

The thinner annular test-rings were treated by quenching in oil from a temperature of 875 deg. C. followed by tempering at temperatures of 350 deg. and 650 deg. C. respectively. The initial hardness of the test-rings was 241 in the annealed condition, a value somewhat higher than that recorded for the annular slices. This is accounted for probably by the fact that these rings, as machined from the drum, represent the central portions of the radial thickness of the material. The rings were taken from the portion of the drum remaining after parting off the annular slices and this portion may have been slightly harder, generally. After hardening, these thinner rings attain a Brinell hardness of 671. This is an exceptionally high figure for oil-quenched material, and is to be ascribed probably to the more effective quenching, due to the thinness of the rings and the possible high combined-carbon content of these rings as the central portions of the thickness of the original material. The effect of tempering is very similar to that noted in the case of the slices, the hardness falling to 518, with a tempering temperature of 350 deg. C. and 255 with a tempering temperature of 650 deg. C.

The attempts to determine the ultimate breaking strength of annular ring-form specimens of malleable cast iron by the methods laid down in B.S.I. Specification 5004 are unsatisfactory. Owing to the ductility of malleable cast iron, the test-rings distort considerably from the circular form before breaking, and for this reason the relationship between breaking load and ultimate breaking strength laid down in the specification is no longer applicable. The test-rings, however, were used for the determination of the modulus of elasticity (En value), the permanent set and the stress deflection relationship up to stress values beyond which the abnormal distortion took place. The stress-deflection curves obtained are illustrated in Fig. 1, and the limits of proportionality included in Table II have been taken from these curves, as the point at which they depart from a straight-line relationship. The En-value or modulus of elasticity was determined exactly as in the manner laid down in the specification referred to previously, and the permanent-set value was determined at a stress value of 14 tons per sq. in. in accordance with the methods described in previous Papers on this subject by the author.

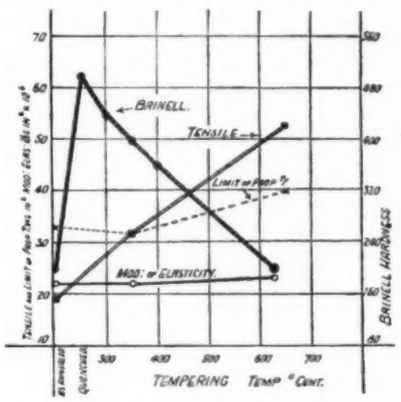

FIG. 2.—TEST RESULTS ON BLACK-HEART MALLEABLE AFTER HEAT-TREATMENT.

TABLE II.—*Mechanical Properties of Centrifugally-Cast White-heart Malleable Cast Iron after Oil Hardening and Tempering.*

Condition.	Dimensions, in.			Hardness.			En value.	Perm. set.	Ultimate strength, tons per sq. in.		Limit of prop.
	Dia.	Radial thick.	Br'dth	As annealed	After O.H.	After O.H. and T.	lbs. per sq. in. ÷ 10^6	Per cent.	Actual	Est.	Tons per sq. in.
As annealed untreated	2.76	0.088	0.257	241	—	—	22.2	5.2	—	33.0	19.0
O.H. 875 deg.C., temp. 350 deg.C.	2.76	0.088	0.259	241	671	518	22.0	1.2	32.0	32.0	32.0
O.H. 875 deg.C., temp. 650 deg.C.	2.76	0.086	0.254	241	671	255	23.2	nil	—	53.0	42.0

Modulus of Elasticity.

In the annealed condition prior to hardening and tempering this material showed a modulus of elasticity of 22.2 million lbs. per sq. in. After oil hardening and tempering at 350 deg. C. this value was practically unaffected, and showed a slight increase of one million lbs. per sq. in. after tempering at 650 deg. C. This increase is equal to approximately 5 per cent. In this respect these specimens behave differently from the grey cast-iron specimens examined in previous investigations, where it was noticed that almost without exception hardening and tempering were accompanied by a slight decrease in the En value.

* Typescript received October 15, 1933.

† "Oil Hardening and Air Hardening Cast Iron." FOUNDRY TRADE JOURNAL, December 4, 1930, and December 3, 1931. Proceedings I. & S. Institute, Vol. I, 1933.

Permanent Set Value.

This is substantially decreased from 5.2 to 1.2 per cent. after oil hardening and tempering at 350 deg. C., and after tempering at 650 deg. C. the permanent-set value is reduced to nil. This reduction in permanent-set value after hardening and tempering malleable cast iron is a repetition of the experience with grey irons after

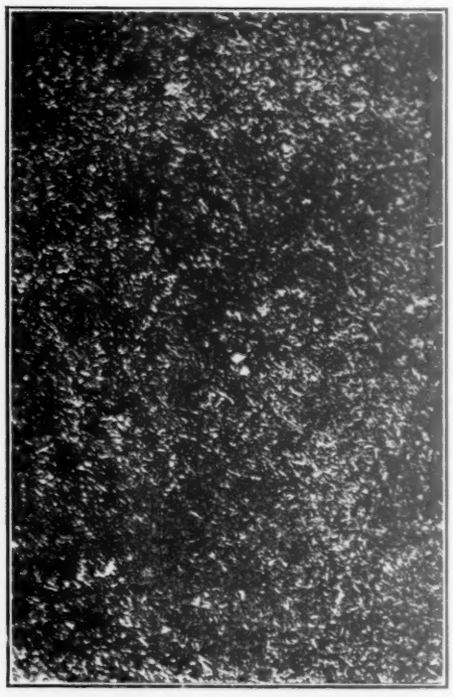

Fig. 3.—White-heart Malleable Quenched at 875 deg. C. in Oil Tempered at 650 deg. C. Etched. ×100.

similar heat-treatments. It is also of general importance to note that white-heart malleable cast iron possesses a substantial permanent set value in the normal annealed condition, even although this is measured at a stress value considerably lower than the limit of proportionality as determined from the stress deflection curves.

Limit of Proportionality.

An inspection of the stress-deflection curves given in Fig. 1 shows that these differ markedly in the position of the point at which the curve changes from a straight line. The stress value at which this point occurs has been designated the limit of proportionality, and occurs in the normal annealed specimen at 19.0 tons per sq. in. In the specimen hardened and tempered at 350 deg. C., this point is raised to a stress value of 32.0 tons per sq. in, and is coincident with the ultimate breaking stress of this specimen. The specimen hardened and tempered at 650 deg. C. shows the extremely high limit of proportionality of 42.0 tons per sq. in. which is followed by a degree of plastic curvature not less than that of the original specimen in the annealed condition.

The significance of the limit of proportionality is that up to the stress values of this limit the degree of plastic deformation undergone is nil, or of a very small order. This property is obviously of considerable value in the service application of material, and there are numerous cases where the resistance to plastic deformation up to high stress values is very desirable. The effect of oil hardening and tempering of these white-heart malleable specimens is to raise the limit of plastic deformation very considerably.

Ultimate Strength.

As indicated already, the measurement of the ultimate breaking strength occasioned some difficulty except in the specimen tempered at 300 deg. C., which broke at a stress value of 32.0 tons per sq. in. without undergoing any plastic deformation. In the case of the two other specimens, the ultimate strength values were calculated, and from an inspection of the stress-deflection curves it will be agreed that the values given are truly representative of the actual. As in the case of grey iron, the effect of oil hardening and tempering has been to bring about a very substantial increase in the ultimate breaking strength.

Brittleness.

The effect of the hardening and tempering treatment on the relative brittleness of the specimens can be estimated from the included areas of the stress-deflection diagrams. The numerical values of these areas at the original scale of plotting are as follow:—

Condition.	Area of stress deflection curve.
Original as annealed	16.1
O.H. and T. at 350 deg. C. ..	6.0
O.H. and T. at 650 deg. C. ..	22.7

The specimen oil-hardened and tempered at 350 deg. C. shows a remarkable and pronounced increase in brittleness, but tempering at the higher temperature of 650 deg. C. increases the toughness very considerably. This, of course, is clearly evident from an inspection of the curves in Fig. 1, and whilst results from a single experiment of this nature are hardly sufficient from which to base general conclusions, it would appear that low-temperature tempering is particularly dangerous in increasing the brittleness after quench hardening.

The diagram Fig. 2 effectively summarises the results described above on the influence of oil hardening and tempering on the properties of these specimens of centrifugally cast white-heart malleable cast iron. The microstructure of the original annealed material was of the coarse-grained pearlitic character typical of the internal structure of white-heart malleable. After oil hardening and tempering the structure is converted to a troosto-sorbitic type of a close uniform grain as illustrated by the photograph (Fig. 3). which shows the specimen after tempering at 650 deg. C.

Further Experiments on White-heart Malleable Cast Iron.

In view of the fact that the above experiments were carried out on specimens of a form not common in industrial testing, it seemed desirable to carry out further experiments on test specimens of more usual types. For these further experiments various specimens of white-heart

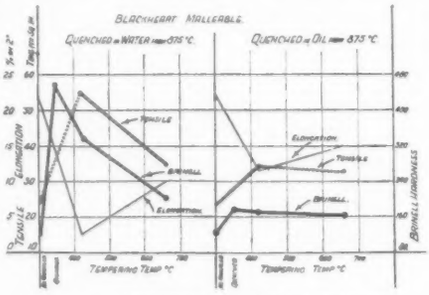

Fig. 4.—Influence of Heat-Treatment on Black-heart Malleable. Cupola Melted.

malleable which came into the author's possession were used. It is not suggested that these specimens are representative of the best practice in white-heart malleable nor were they specially prepared. The justification for using them in experiments of this nature lies in the fact that it is desirable to explore the effect of such heat-treatments on ordinary common grades of material which are made in the industry.

The first of these experiments was performed on three flat-bend test-pieces of white-heart malleable of the type in common use. These were treated as follow:—(*a*) Retained in the annealed condition as received; (*b*) hardened by quenching in oil from 850 deg. C., *not* tempered; and (*c*) hardened by quenching in oil from 850 deg. C., tempered at 650 deg. C.

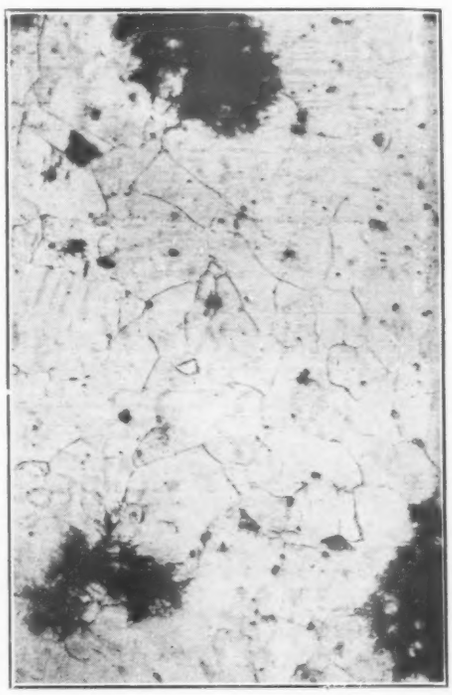

Fig. 5.—Black-heart Malleable as Annealed. Etched. ×100.

The flat-bend tests were then broken in the tensile-testing machine, with the following results:—

	Tensile strength, tons per sq. in.	Per cent. on 4 in.
(*a*) As received	16.2	2.0
(*b*) O.H. 850 deg. C., not tempered	19.0	Nil
(*c*) O.H. 850 deg. C., tempered. 650 deg. C.	21.1	2.0

The hardening treatment has had the effect of increasing slightly the tensile strength, and all traces of elongation have disappeared. Hardening followed by tempering at 650 deg. C. is accompanied by an increase of over 25 per cent. in tensile strength and the recovery of the elongation to the original "as annealed" value. The broken specimens from the above experiments were sawn into small pieces about 1½ in. in length, and were re-hardened by quenching and tempering in various manners with the object of studying the effect of quenching temperature and media on the hardness attainable. The results obtained are summarised in Table III. The Brinell hardness determinations were made on the flat surface after grinding a smooth surface, and also on the end cross-section about the middle of the thickness of the specimen. This enabled the effect of the treatment to be observed on the hardness of the outer skin and inner core of the specimens. After the Brinell examination each specimen was broken for observation of the fracture.

The hardness values obtained on the skin of the specimens are very irregular. This may possibly be ascribed to irregular composition of this portion and is probably to be expected.

Quenching in water has a much greater effect in increasing the hardness than quenching in oil. The lower quenching temperatures are accompanied by effective hardening and a much closer,

TABLE III.—*Effect of Quenching from Different Temperatures in Water and Oil on Specimens of Sand Cast White-heart Malleable Cast-Iron.*

Quenching.	Brinell hardness after			
	Quenched in water.		Quenched in oil.	
Temp., deg. C.	Skin.	Core.	Skin.	Core.
750	196	671	163	278
800	293	774	269	390
850	156	774	302	390
900	302	774	320	352
950	170	774	156	435
1,000	170	746	179	328

uniform and better fracture was observed in the cores of the specimens. With the higher quenching temperatures the fracture in the heart of the specimens became much coarser and more crystalline, whilst the white decarbonised skin changed from a crystalline to a beautifully fibrous fracture. The hardness values show a slight tendency to fall with the higher quenching temperatures.

TABLE IV.—*Effect of Tempering on Specimens of Sand-Cast Malleable Cast Iron after Quenching in Water from a Temperature of 800 deg. C.*

Specimen No.	Tempering. Temp., deg. C.	Hardness.	
		Skin.	Core.
7	350	269	418
1	400	342	448
2	450	375	431
5	500	156	321
6	600	218	294
4	700	207	207

The effect of tempering specimens of this material on the Brinell hardness after quenching in water from a temperature of 800 deg. C. is summarised in Table IV. The results show that tempering at successively increasing temperatures is accompanied by a steady lowering of the hardness values of the core obtained by quenching. Here, again, this batch of specimens shows considerable irregularities in the hardness of the skin after treatment.

In view of the irregular hardness of the skin after heat-treatment, a further short study of the distribution of the hardness across the section of this material was made. This was done by taper grinding the end of the specimen. Brinell impressions taken at four equal intervals gave the Brinell hardness at equal intervals of approximately 0.040 in. below the surface. The results obtained are given in Table V below:—

TABLE V.—*Brinell Hardness Tests on Heat-Treated Malleable Cast Iron.*

	Brinell hardness position No.								
	1.	2.	3.	4.		1.	2.	3.	4.
Quenched 850 deg. C. water ..	305	587	671	671	Temp. 600 deg. C. ..	245	245	245	245
,, 850 deg. C. oil	344	335	344	344	,, ,, ..	226	255	255	255
,, 800 deg. C. water ..	390	671	671	671	,, ,, ..	226	278	266	266
,, 800 deg. C. oil	220	352	412	671	,, ,, ..	226	245	245	245

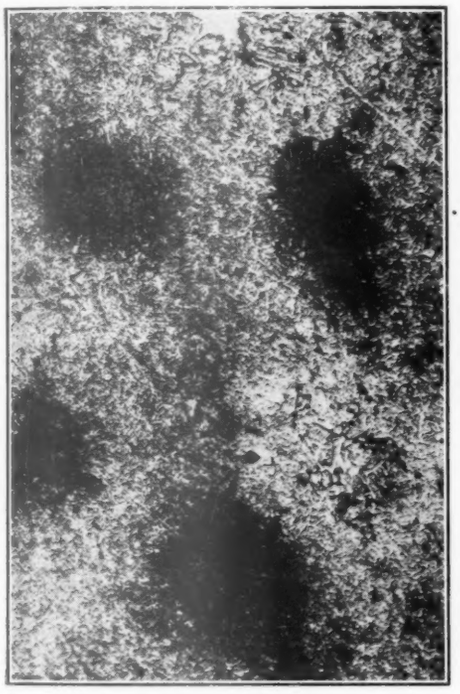

FIG. 6.—BLACK-HEART MALLEABLE QUENCH 875 DEG. C. IN WATER TEMPERED 420 DEG. C. ETCHED. ×100.

FIG. 7.—BLACK-HEART MALLEABLE QUENCHED AT 875 DEG. C. IN WATER AND TEMPERED AT 660 DEG. C. ETCHED. × 100.

FIG. 8.—BLACK-HEART QUENCHED AT 875 DEG. C. IN OIL TEMPERED AT 420 DEG. C. ETCHED. ×100.

At position (1) approximately 0.040 in. below the surface slight hardening is observed in all specimens except that quenched at 800 deg. C. in oil. Further into the heart of the specimen the hardness increases and reaches a substantially uniform value. Tempering at 600 deg. C. reduces the hardness to a low figure again, substantially uniform throughout the whole of the specimen. Consideration of these results would appear to show that this in the main is due to the irregular distribution of the carbon content.

A further series of standard tensile test-bars of white-heart malleable in the annealed condition were treated and examined. The results obtained are set forth in the accompanying Table VI.

The tensile strength results show a remarkable increase due to the hardening effect and a recovery in the ductility as measured by the elongation due to the tempering. The increase in strength is obtained under conditions of both oil and water quenching, and observation of the fracture shows that oil quenching appears to be accompanied by equivalent grain refining to water quenching. The effect of the heat-treatment in grain refinement is of particular interest and importance.

Black-heart Malleable.—A series of tests were carried out on standard specimens of black-heart malleable cast iron. The specimens obtained were described as "black-heart malleable, cupola melted." The test results, after treatment both by oil and water quenching, followed by tempering, are set out in Table VII.

These test results are plotted in the diagram Fig. 4. In these specimens quenching in water is accompanied by an increase in Brinell hardness, and tempering at 420 deg. C., whilst bringing about a drop in the hardness value, is accompanied by an ultimate strength of over 50 tons per sq. in. and an elongation of 2 per cent. Tempering at a higher temperature of 640 deg. C. brings about a further recovery of the elongation value to 10 per cent., with a drop in Brinell hardness to 200 and ultimate strength to 38.6 tons per sq. in. This value is

TABLE VI.—*Hardening and Tempering Standard Test-Bars Sand-Cast White-heart Malleable Cast Iron.*

Condition.	Dia., in.	Tensile tons per sq. in.	Per cent. on 2 in.
Original annealed	0.60	22.7	4.0
Quench water—			
800 deg., temp. 300 deg. C.	0.60	35.6	1.0
,, ,, 400 deg. C.	0.60	25.4	2.0
,, ,, 600 deg. C.	0.60	39.5	2.0
Quench oil—			
800 deg., temp. 550 deg. C.	0.58	39.3	1.5
,, ,, 600 deg. C.	0.60	36.9	2.0

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approximately 65 per cent. greater than the original ultimate strength value, and the reduction in elongation is approximately 50 per cent. Oil-quenching is not accompanied by any very great increase in Brinell hardness, but with the corresponding tempering treatment the tensile strength is raised and the elongation undergoes considerably less reduction. Photomicrographs of these specimens in the etched condition at a magnification of 100 diameters are illustrated in Figs. 5 to 9.

In the case of oil-quenching, it is evident that in the specimens examined the speed of cooling has not been sufficient to retain any substantial hardening effect. The micro-examination reveals clear evidence of reprecipitation of the ferrite, and this structural alteration has been accompanied by a substantial increase in strength value, with a sacrifice of some elongation in the tempering range tested.

A deduction from these results which deserves some prominence is that, with a suitable heat-treatment by hardening and tempering, the properties of black-heart can be made to resemble closely those of good white-heart malleable. This is a point of some industrial importance.

The author would like to conclude by expressing his appreciation of the courtesy extended to him by Messrs. Bradley & Foster, Limited, in whose laboratories a great deal of this work was carried out.

Table VII.—*Tests obtained after Hardening and Tempering Black-heart Malleable Cast Iron Cupola Melted.*

Specimen No.	Condition.	Dia. of test-piece.	Ultimate strength, tons per sq. in.	Elongation per cent. on 2 in.	Brinell.
1	As annealed	0.58	23.2	22.0	120
2	Quenched in water, 875 deg. C.	0.60	—	—	460
3	.. .. temp. 420 deg. C.	0.60	54.9	2.5	340
4	.. .. 660 deg. C.	0.60	38.6	10.0	200
5	.. .. oil ..	0.58	—	—	180
6	.. .. 420 deg. C.	0.58	34.6	11.5	175
7	.. .. 660 deg. C.	0.62	32.5	15.0	160

In the specimens quenched in water the original ground-mass of ferrite is replaced by a martensite-sorbite structure in the hardened-and-tempered specimens and in the oil-quenched and tempered specimens it is evident that ferrite has been reprecipitated in grains showing thick boundaries of a troostitic character.

In spite of the practically complete absence of combined carbon in these samples of black-heart malleable, they are susceptible to hardening by quenching in water from a temperature of 875 deg. C. This hardening effect is accompanied by an increase in tensile strength and a reduction in elongation value. The tensile strength and hardness attained by quenching fall steadily by tempering at increasing temperatures and the elongation value tends to recover.

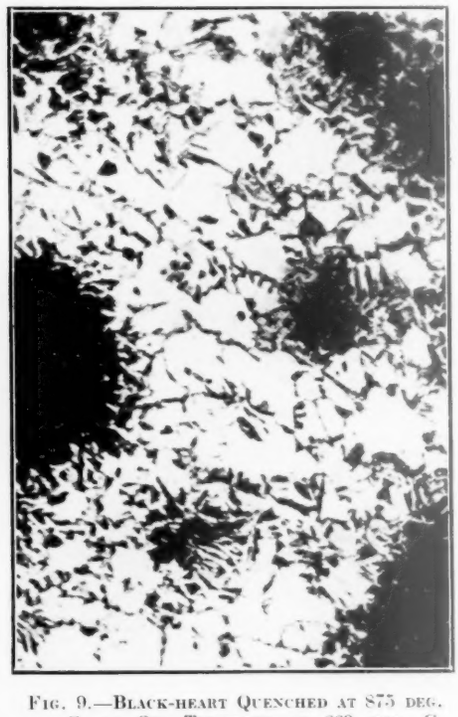


Fig. 9.—Black-heart Quenched at 875 deg. C. in Oil Tempered at 660 deg. C. Etched. ×100.

At a tempering temperature of 660 deg. C. the strength value was 65 per cent. greater than the original material, and the percentage elongation value of 10 per cent. was approximately 50 per cent. of that in the annealed condition. It is highly probable that the hardening effects obtained are brought about through the resolution of the temper carbon on reheating.

The Cunard Mammoth Castings.

LESSONS FROM LARGE CASTINGS.

A lecture, illustrated by lantern slides and a cinematograph film, was given before the Lancashire Branch of the Institute of British Foundrymen by Mr. F. Swift, of Darlington, upon "The Manufacture of the Mammoth Cunard Castings."* The cinematograph film was shown by the courtesy of the Metropolitan-Vickers Amateur Cinema Society, Messrs. Clough and Ankerson operating the apparatus.

Vote of Thanks.

Mr. E. Longden (Manchester) proposed that a hearty vote of thanks be accorded to Mr. Swift for his lecture. The mention which had been made to the "Mauretania" in the lecture was very interesting to him, because he had twice crossed the Atlantic in her; he also happened to have been engaged on some of the largest turbines of her sister ship, the "Lusitania." Problems in foundry work were more intensified in the case of steel practice. Reference had been made to headers, and he would like to know the amount of metal required to produce the type of casting shown on the screen. It would be interesting to know the amount of metal required to pour a 120-ton casting. The problem of securing apprentices for this class of work was likely to become more acute as time went on. He did not agree with the lecturer with regard to the method of drying the moulds. At one time, probably 15 years ago, he (the speaker) thought there was nothing quite so good as the old kettles, but he had learned better and could now dry much more effectively with the hot-air portable stoves. One secured more economic and thorough drying of the remote parts of the mould without injury.

Mr. H. V. Grundy (Brooklands) seconded the vote of thanks to the lecturer for his lecture, which he had greatly enjoyed, because the Lancashire Section did not appear to have many lecturers on steel castings.

The vote of thanks was carried unanimously by acclamation.

Mr. Swift, in acknowledging the vote of thanks, explained that he had only dealt with the main part of his subject, and that if he had gone into it fully he could have spoken for at least three hours to an interested audience.

A question had been asked with regard to headers. There were 570 tons of castings and 1,000 tons of steel to cast the lot. Some of them had 70 per cent. and some had 25 per cent. Of course, there were bolts and nuts, etc., with it. The 75 per cent. related to the smaller castings, while the larger ones were down to 25 per cent.

Reference had also been made to the method of drying with coke. He was of the opinion that it would be rather a difficult thing to dry jobs of that description satisfactorily by any other method, because it was not just a question of drying and closing in a day. The larger pieces took 15 to 20 shifts of men for closing prior to casting. They had to be bone-dry and not merely surface-dry; bone-dry from back to front. It could be imagined that if there was any dampness whatever within two, three, or even six inches from the surface of the mould, there would be a very great danger of striking back to the face, and that would be disastrous.

DISCUSSION.

Mr. W. West (Preston) said that the story told by the lecturer was so thrilling that it was most difficult to criticise it. In regard to the manufacture of the castings described in the lecture, what was the type of sand in which the moulds were made? He remembered that sand mixing was a particularly secret process in his apprenticeship days at the Darlington Forge. Being a "nosey" youth he often tried to "look in" while it was being mixed, but he was invariably chased out. In the small steel foundry a quantity of tar-bonded sand was used, and in old days it was also largely used in the big foundry.

With regard to annealing, he could confirm the temperatures that were used in the days before the war, due to the fact that there had to be an average temperature in the casting of 950 deg. C. Since his association with the Darlington Forge he had often proved that to tin the diabolo chaplets referred to by the lecturer was very useful. If there was not the weight of metal around the stud, it prevented a certain amount of fluttering which might occur when the casting was lighter.

Were the cores given a silica paint, as it was termed in Lancashire? He noticed that they were white, but he did not know whether they had been whitened just for the purpose of making an impression or whether it was silica paint. He also asked, when he saw the pattern, as to which way the casting was poured; because he remembered that the cast used to be made with the shaft brackets upwards, and he noticed it had been placed downwards in the illustration. It would probably be more effective that way than the other.

Sand Problems.

Mr. Swift stated that 500 tons of "compo" from Sheffield were used. Tar sand was only used in the small foundry for castings up to, approximately, 10 cwts. When the "compo" from Sheffield was used, the "pot" was added to suit particular requirements. It was painted after the moulders had sleeked it. It was then painted with blacklead and sleeked over again. There was nothing used in the ordinary sense of silica paint; but merely ordinary plumbago painted over with a swab and then sleeked.

Dealing with the annealing temperatures, for the first 12 hours things were taken very steadily indeed. On some of the kilns there were oil-burners and on others oil-burners and a coal fire. The first 12 to 24 hours was taken very steadily indeed on account of not getting the thinner structure to too great a heat before the other was penetrated, because that would be as bad as having the pull in the floor. Chemists, with pyrometers, were controlling the castings.

* See Foundry Trade Journal, Vol. XLVI, page 215.

It was necessary for a period of 4 to 5 days to elapse before the maximum heat required was arrived at. It was then gradually taken back, and 14 to 16 days elapsed before they could be taken out of the kiln.

MR. J. S. G. PRIMROSE (Manchester) pointed out that the lecturer had stated that the steel used was of the order of 0.24 to 0.2 carbon in the furnace. After that it would be carburised, bringing it up to 0.3 carbon, by which greater strength was obtained, especially in impact value. What amount of manganese was present?

MR. SWIFT said he had brought a sheet of mechanical tests with him. The carbon was taken by the "button" sample before casting. The list gave particulars of all the pieces with their cast numbers, tensile strength, elongation and bending tests, and carbon content for each piece. The average carbon content was about 0.31.

Contraction Difficulties.

MR. E. LONGDEN asked Mr. Swift to explain the mechanism of the contraction ribs shown on the screen.

MR. SWIFT said that the subject of bracketing was very complicated. What one moulder might think was advisable to bracket another might think was inadvisable. The advice his father had always given him was to put cost second; make a good job first. If there were any likelihood of a pull, put on a bracket; if there was no pull the bracket could always be cut off.

MR. E. LONGDEN inquired what had been the lecturer's experience with regard to chills; had they failed him?

MR. SWIFT said he had done very little with chills in the sense of outside chilling.

MR. E. LONGDEN said he was referring to internal chilling fitted in the mould.

MR. SWIFT said he had a complaint about some wheel centres. With an ordinary plain wheel centre 12 different methods of casting had been tried. The outside chilling was tried on it, and as a result there were five pulls in which one could put one's fingers in the rim. A question to consider would be what amount of thickness was necessary; there might be a possibility of the chilling fusing on. If a casting was worth making at all, it was worth making sound. He would not, as an engineer, tolerate a casting that had any false material in it whatever. Plenty had to go in to make a job safe by studs without applying false material such as chills to save putting a head on. He considered it was bad practice. He did not think that chilling outside could be satisfactorily carried out on the kind of jobs described in the lecture. He was certain that it could with small work with thicknesses ranging from ¾ to 2 or 3 in.; but above that one was getting into rather a dangerous zone.

Chills for Steel.

MR. J. S. G. PRIMROSE said that one point which was quite apposite with regard to chilling was that Mr. Longden was chiefly concerned with cast iron. With 3 to 4 per cent. of carbon the silica was not going to push out any of the carbon.

MR. E. LONGDEN disagreed. The chilling of the steel in these junctures and vulnerable sections would have the effect of freezing off those thicker sections earlier, and allows the headers and feed gates to function.

MR. WALTER MACHIN, foundry manager, Vickers-Armstrong, Limited, Barrow-in-Furness, said that stern frame castings had given trouble in American cruisers of recent years due to trouble caused by contraction difficulties. The lecturer had not told them how these large castings he had supervised had come out to size compared with the patterns he made them from; *i.e.*, could he say what size was the largest casting in length, and how he found it regarding finished size compared with the pattern as he received it from the pattern-maker, also what contraction allowance was allowed on the pattern, as it was quite usual to get freak contraction in castings made of steel?

MR. SWIFT said that the stern frame described in the lecture was 101 ft. 8 in. long. With respect to contraction, no particular readings of the castings were taken because it was a very difficult job. When the order referred to in the lecture was given it was accompanied by definite instructions that there were to be no welding, no burning, and no patching up. No heads were to be removed until the inspector saw them. There were 150 heads ranging from 10 in. up to 28 in. diameter, and not one of them was sawn off. They were all burnt off with acetylene.

MR. J. MCPHERSON (Vickers-Armstrong, Limited, Barrow) asked if Mr. Swift was satisfied with the amount of heads on the shaft bracket.

MR. SWIFT said there was no trouble whatever. There were 120 heads, and when they had all been burnt off there was not a pinhole under any one of the heads.

The proceedings then concluded.

Chromium in Malleable Iron.

By HERBERT R. SIMONDS.

In an effort to develop a wear-resistant malleable iron, Miss Rebecca Hall experimented with the effect of chromium additions in malleable iron. Her tests covered chromium from 0.25 to 1.15 per cent. with the silicon controlled and varying from 1.02 to 2.02 per cent. In a report before the last convention of the American Foundrymen's Association, Miss Hall stated that the maximum tensile strength was secured when the chromium content was 0.84 and the silicon 1.57. Some producers of alloying elements apparently were much encouraged by Miss Hall's report, as they saw in it a possibility of an increased use not only of chromium, but of other similar additions. Perhaps taking the wish for the deed, they have exaggerated the importance of the new chromium malleable product reported by Miss Hall. Statements recently have been made on both sides of the question as to whether chromium is potentially a good alloying element for malleable iron. The predominance of opinion seems to be against its practical use, and the following comment from Dr. Enrique Touceda, consulting engineer, Malleable Iron Research Institute, Cleveland, gives most of the essential features in the discussion.

"From Miss Hall's Paper it was clear that no claim was made that the fracture of the chrome malleable castings was normal, that ductility was anything but moderate, or that machinability would equal that degree expected of regular malleable iron. To try and make this whole subject a little clearer, I would like to point out that in the early days the chief cause of the failure of malleable-iron castings in service resulted from the fact that the castings were graphitised, consequently they were not much superior to grey iron. It was only when the plants became convinced that the composition of the mixture had to be so proportioned that primary graphite would be absent in even the thinnest sections that failures of this character were eliminated. Any attempt, therefore, to offset the injurious effect of chromium by silicon, even if otherwise efficacious, would certainly be doomed to failure as far as regular malleable-iron practice is concerned, because the danger from graphitisation increases with the increase in silicon.

"Just the amount of chromium that safely can be present in a malleable-iron product, without danger of its being rejected due to abnormal fracture, unfortunately cannot be definitely stated. Some plants claim to be able to run without trouble on a chromium content as high as 0.035 per cent. Others have found with this percentage that, on occasion, they do receive complaints that their castings do not machine with sufficient ease and that the fractures are somewhat steely. In such cases a metallographic examination has shown that, while the fracture was abnormal, the structure was normal in all particulars. In such instances, therefore, little doubt remains but that the trouble had been caused by chromium.

"Some foundries even state that they have experienced no difficulty when the chromium content in the casting was as high as 0.06 per cent., but by far the majority never come anywhere near this high a percentage. In my own experience I have never found a casting containing as much as 0.06 per cent. chromium that was not deficient in ductility, hard to machine and of abnormal fracture. The result of a long series of tests through ladle additions of ferro-chromium indicates that the danger point as to abnormality of fracture is in the vicinity of 0.035 per cent. chromium.

"No investigator with whom I am familiar has thus far found an agent successfully to neutralise the evil effects of chromium in malleable iron. It is true some elements do offset certain of the disadvantages of chromium, but they all introduce other troubles."

Subject Still Unsettled.

The comment of Dr. Touceda is based on practical experience with malleable foundries, and it should not be considered as irrevocably barring the use of chromium in malleable iron. The whole subject is still in a somewhat unsettled stage. Some foundries very definitely are using 0.04 per cent. chromium without disastrous effect and many research engineers feel that there is a possibility of developing a malleable alloying technique which may include fairly high percentages of chromium. Some of the comments received in support of chromium indicate that its bad reputation among malleable foundrymen is at least partially unwarranted. Chromium will cause trouble if other conditions are not carefully controlled, and perhaps the most practical way for the foundryman to meet this situation is to follow Dr. Touceda's suggestion and limit the chromium in his pig-iron to around 0.035 per cent. when no steel scrap is to be used in the mixture. If steel scrap is to be used, the chromium in the pig-iron, of course, should be still lower as a safeguard against possible chromium in the scrap.

One of the difficulties in discussing problems in the malleable-iron field comes through the lack of a standard definition of malleable iron. Thus a group of alloy irons produced in malleable foundries by a so-called shock anneal method has characteristics similar to steel. Other products of the malleable foundry are closer to cast iron. The whole malleable industry is expanding to include a constantly increasing line of alloy irons and a changed technique of anneal resulting in castings which differ in composition, in structure, in tensile properties, and in machinability from the product generally recognised under the definition of malleable iron.—"Iron Age."

Under-Water Welding.—The following are the conclusions contained in a Paper on "Electric Arc Welding Under Water" presented by MESSRS. N. S. HIBSHMAN and C. D. JENSEN to the American Welding Society recently:—(1) Welds of good quality may be made on low-carbon steel under water; (2) this method of welding may be found of use in experimental work where it is desired to limit the heat penetration from the weld or avoid distortion of the parent material from excessive heating or where it is desired to make a weld shielded from nitrogen and other gases present in the air; (3) cast iron is regarded as being as weldable in water as in air.

XUM

This Week's News in Brief.

Trade Talk.

The Consett Iron Company, Limited, has put another furnace into blast, and 50 additional men have been given work.

The Vitkovice concern, of Czecho-Slovakia, has recently received considerable orders for the supply of rails to Soviet Russia.

Messrs. Stewarts and Lloyds, Glasgow, have received the contract for the supply of 9,400 yards of water pipes for Manchester Corporation.

Messrs. Robert Melvin, Limited, Alloa, have received an order from the L. & N.E. Railway for 1,100 tons of cast-iron permanent-way chairs.

The North British Locomotive Company, Limited, Springburn, Glasgow, has secured an order from the Bombay & Baroda Railway, India, for seven duplicate locomotive boilers, for superheated locomotives.

Messrs. Scotts Shipbuilding & Engineering Company, Limited, Greenock, have received an order from London owners for a passenger and cargo motorship. The propelling machinery will be constructed by the builders.

After January 1, the London offices of Marshall, Sons & Company, Limited, engineers and boilermakers, Gainsborough, will be at Brettenham House, Lancaster Place, Strand, London, W.C.2. ('Phone, Temple Bar 5792 and 5793.)

During the past week cargoes for the Carron Company, totalling 15,000 tons, have been unloaded, two vessels from Bilbao bringing 9,000 tons and one from North Africa, 6,000 tons. Another vessel has discharged 2,500 tons for Messrs. William Baird & Company, Limited, Glasgow.

Messrs. J. H. Robinson & Company (Liverpool), Limited, have purchased the Lukas Works in that city. Besides being gas-meter manufacturers, Messrs. Robinson also supply hot-pressed stampings, and it is this branch of work that has necessitated the purchase of the Lukas Works.

A turntable, 70 ft. in diameter, and weighing several hundred tons, is being built by the L.M.S. Railway Company at Polmadie Works, Glasgow. It is to turn the new Royal Scot engines, the present turntable, whose diameter is 50 ft., being too small for the larger type of locomotive.

Messrs. C. A. Parsons, Limited, Heaton Works, Newcastle, have received an order for a large turbo-compressor, capable of delivering 900,000 cub. ft. of gas per hour at an absolute pressure of 154 lbs. per sq. in. The compressor will run at a speed of 5,670 r.p.m., and will be driven by step-up gearing from a steam turbine running at 3,300 r.p.m.

Messrs. James Bennie & Sons, Limited, Clyde Engine Works, Govan, Glasgow, have received some very large orders from the Continent, and have begun day and night shifts. The orders were obtained in the face of keen competition from home and foreign firms. Messrs. Bennie have also on hand a large amount of Admiralty work, and the works will be kept fully employed for some months.

The employees of the following firms have distributed from the works and benevolent funds to infirmaries and other charitable institutions in Glasgow and the West of Scotland:—Messrs. James Howden & Company, Limited, Glasgow, £195; Messrs. Babcock & Wilcox, Limited, Tube Works, Dumbarton, £130; the Argus Foundry Company, Limited, Thornliebank, Glasgow, £34; the Etna Iron & Steel Company, Limited, Motherwell, £78 10s.; Messrs. Barr & Stroud, Limited, Anniesland, Glasgow, £145.

An order for a cargo and timber-carrying steamer of 2,850 tons deadweight has been placed by Messrs. Glen & Company, Limited, Glasgow, with the Burntisland Shipbuilding Company, Limited. This is the fifth vessel to be built at Burntisland for Messrs. Glen in recent years. She will embody the latest features in design, and the propelling machinery will be supplied by Messrs. David Rowan & Company, Limited, Glasgow. The Burntisland yard has also obtained an order from the London & Channel Island Steamship Company, Limited, London, for a steamer of 1,160 tons deadweight. The order is a repeat order of the "London Queen," built early last year, and is intended for the owners of the Channel Island service. Messrs. David Rowan & Company, Limited, will supply the propelling machinery. The vessel will be designed on the Burntisland "Economy" principle, which experience has shown ensures high efficiency and fuel economy.

Commercial Moulding and Sand Control for the Modern Ironfounder.

(*Continued from page* 352.)

from three blows of a 14-lb. weight falling through a distance of 2 in., when a uniformly-rammed cylindrical test-piece should be obtained exactly 2 in. in dia. by 2 in. high, as indicated by the gauge marks fitted to the top of the rammer-frame casting.

The rammed test-piece is now removed from the corebox and broken on a compression testing machine, as shown in Fig. 4A, and the load required to effect fracture divided by 3.14 gives the green compression strength in lb. per sq. in. The spring balance on the machine reads up to 50 lb. If the dried compressive strength is desired, a similar test-piece is rammed up, dried in the stove, and then broken on another form of testing machine of greater loading capacity. In the author's firm they have devised a special compression link for fitting to a standard cement-testing machine for service in this direction, and this is illustrated in Fig. 5. Using this attachment, loads up to ½ ton can be applied.

(To be continued.)

Company Reports.

W. & T. Avery, Limited.—Interim dividend of 5 per cent. on the ordinary shares.

Bertrams, Limited.—The board propose to maintain the dividend at 7½ per cent., less tax.

British Oxygen Company, Limited.—Dividend for the half-year ending December 31 on the 6 per cent. preference stock.

Allied Ironfounders, Limited.—Interim dividend for the half-year ended September 30 on the 7 per cent. cumulative preference shares.

Duffield Iron Corporation, Limited.—Development expenditure during the year to September 30 amounted to £7,227, increasing the total to date to £36,141.

Atlas Steel Foundry & Engineering Company, Limited.—Loss for year, £5,221; debit balance brought in, £1,576; depreciation, £1,500; total debit carried forward, £8,297.

Zinc Manufacturing Company, Limited.—Net loss of £31,038 for the year ended June 30, increasing the accumulated debit on profit and loss account to be carried forward to £194,090.

Cargo Fleet Iron Company, Limited.—Profit for year ended September 30, £70,805; brought in, £189,755; debenture interest, £35,598; depreciation, £30,000; carried forward, £192,263.

Shotts Iron Company, Limited.—Profit, after providing for debenture interest, £13,819; brought in, £301; transferred from reserve, £15,000; depreciation, £25,000; carried forward, £4,120.

Electric Furnace Company, Limited.—Interim dividends for the half-year ended September 30 of 3½ per cent. on the cumulative preferred ordinary shares and 2½ per cent. on the ordinary shares.

Stewarts & Lloyds of South Africa, Limited.—Gross profit, £75,031; net profit, £53,082; brought in, £1,418; preference dividends, £35,500; written off from investments and goodwill, £10,625; carried forward, £8,375.

Crittall Manufacturing Company, Limited.—Trading profit, £69,636; brought in, £2,197; transferred from general reserve, £45,163; carried forward, after providing for debenture and other interest, etc., £2,342.

New Company.

Cincinati Milling Machines, Limited.—Capital £50,000. Subscriber: C. Russell, 137, Oakleigh Park Drive, Leigh-on-Sea.

Personal.

Mr. William Fraser has resigned his position as joint managing director of Messrs. Johnson & Phillips, Limited.

Prof. Henry Louis, the well-known mining engineer, Emeritus Professor of Mining at Armstrong College, Newcastle-upon-Tyne, has celebrated his 78th birthday.

Mr. William Joseph Brooke, general manager of the Normanby Park Steelworks of Messrs. John Lysaght, Limited, Newport, Bristol and Scunthorpe, has been appointed a joint managing director of the company.

Mr. T. Dickson Richards has been elected to the board of directors of Messrs. W. Richards & Sons, Limited, Dinsdale Moor Ironworks, Middleton St. George, Durham, and Britannia Foundry, Middlesbrough. The works were established by the late Mr. William Richards in 1875. His son, Mr. Walter Richards, is managing director, and Mr. T. Dickson Richards, his grandson, now becomes a director.

Contracts Open.

Forgandenny, December 27.—Supply and laying of 3,000 yds. of 3-in. water pipes, etc., for the Perth County Council. Messrs. H. J. Bell & Company, 18, Charlotte Street, Perth. (Fee £1 1s., returnable.)

Wellington, Som., January 5.—C.I. pipes, etc., for the Urban District Council. Messrs. Rofe & Raffety, 208, Abbey House, Victoria Street, Westminster, S.W.1. (Fee £2 2s., returnable.)

Obituary.

Mr. Robert Benjamin Wragg, chairman of Messrs. Thomas Wragg & Sons, Limited, and of Messrs. James Woodward, Limited, firebrick manufacturers, of South Derbyshire, has died at the age of 66.

Lieut.-Colonel John Stanley Watson, founder and chairman of Messrs. Watson, Saville & Company, Limited, steel manufacturers, of Sheffield, died recently in a Sheffield nursing home. He was 77 years of age.

Aged 78, Mr. William B. Hossack, retired engineer, has died at his home in Airdrie. He was a native of Banff, and went to Airdrie 50 years ago and engaged in foundry and engineering work with the late Mr. Gardner Inglis, founding with him the extensive engineering and boiler works at Cairnhill.

The death occurred suddenly on Saturday at his residence, 9, Ashburton Avenue, Claughton, Birkenhead, of Mr. John Alfred Sattersfield Hassal, secretary of the Engineering and Allied Employers' Association (Liverpool District), the Liverpool and District Ironfounders' Association, and the National Ironfounding Employers' Federation.

Mr. Ernest Frederick Thomas, of Park House, Great Barr, Birmingham, died recently at the age of 63 years. Mr. Thomas was well known in the iron and coal trade of Walsall and district, and was one of the principals of Messrs. G. & R. Thomas, Limited, Hatherton Furnaces, Bloxwich. Since the age of sixteen he had been associated with the Hatherton Furnaces, and on the death of his father in 1920 he took over the control in conjunction with Mr. William Musgrove.

Mr. Henry H. Westinghouse has died at Goschen, New York. He was 80 years of age. Mr. Westinghouse gained fame for his invention of the single-acting steam engine. He organised a company and marketed this invention in almost every country in the world. He also invented many improvements to the air-brake invented by his brother, George Westinghouse. He began his career in 1872 in the Westinghouse Air-Brake Company, founded by his brother at Pittsburgh, becoming chairman of the company in 1915.

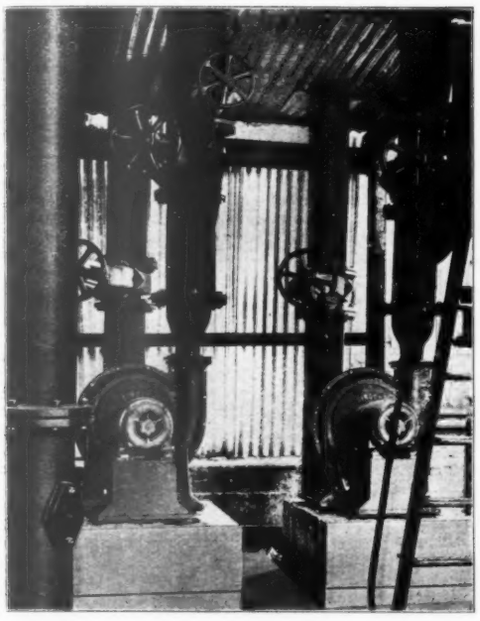
Applications to Register Trade Marks.

The following list of applications to register trade marks is extracted from the "Trade Marks Journal":—

"Sunwat."—Metal goods. Beckett, Laycock & Watkinson, Limited, Acton Lane, London, N.W.10.

"Hibrinal" and "Metcast."—Cast metal goods. Metal Castings, Limited, Droitwich Road, Worcester.

A NEW TRADE SIROCCO MARK CATALOGUE!



No. S.F. 26 dealing with "Sirocco" Fan Manufactures for moderate and high pressures. It includes some interesting examples of recent installations and contains detailed and accurate information concerning duties, weights and dimensions for the wide range of sizes and designs listed. In addition, numerous tables assist in determining the most suitable "Sirocco" Fan Equipment for use under diverse operating conditions.

A copy for reference is indispensable.

Write to

DAVIDSON & CO., LIMITED,

SIROCCO ENGINEERING WORKS, BELFAST.

LONDON : MANCHESTER : NEWCASTLE : BIRMINGHAM : CARDIFF : BRISTOL : GLASGOW : DUBLIN

universally recognised as the leading brand of Cylinder Pig Iron

WARNER CBR

The way to BETTER castings

WARNER & CO. LTD. CARGO FLEET MIDDLESBROUGH

Raw Material Markets.

Business in the iron and steel markets has fallen away, in view of the holidays. Present indications point to very favourable conditions on the re-opening in the New Year. The producers of pig-iron are well booked for the first six months of 1934, and, in view of the firmness of the market, increased quotations are expected in some quarters. Production is being increased. The output of pig-iron last month was the highest recorded this year.

Pig-Iron.

MIDDLESBROUGH.—The Cleveland foundry-iron market has maintained a very firm tone. Stocks of iron are reported to be all sold, the current output is entirely booked, and the makers are turning away offers of forward business. In view of these circumstances, it is not surprising that a rise in quotations is thought to be probable at the beginning of the New Year, when prices will be reviewed by the Ironmasters' Association. Owing to the shortage of supplies, Cleveland iron has, to a certain extent, lost business to iron from the Midlands, not only in Scotland but also in this district. Further steps are being taken to increase the output at Middlesbrough. The home quotations for No. 3 Cleveland G.M.B. remain at 62s. 6d. delivered Middlesbrough, 64s. 6d. delivered North-East Coast, 62s. 3d. delivered Falkirk and 65s. 3d. delivered Glasgow. No. 1 is 2s. 6d. per ton more than No. 3, and No. 4 foundry and No. 4 forge 1s. less than No. 3.

The makers of East Coast hematite are fully sold for some months ahead, and the market is consequently very firm. An early increase in prices would not be unexpected. Owing to repair stoppages, there are now only six hematite furnaces in blast here, in comparison with seven a fortnight ago.

LANCASHIRE.—Deliveries of pig-iron to consumers have slackened off, in anticipation of the holidays, and there is also little new business being done. For delivery to users in the Manchester district, Derbyshire, Staffordshire and North East Coast brands of No. 3 foundry are quoted at 67s. per ton, with Northamptonshire at 65s. 6d. and Scottish foundry at from 79s. to 80s.

MIDLANDS.—As hitherto, the light-castings foundries form the busiest section of the pig-iron consuming trades in this district, the general engineers being poorly employed. All the large users of pig-iron have booked their supplies up to the end of March, in some cases to June. The makers will not book beyond the latter month at the current rates. Quotations remain at 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, including delivery to Birmingham and Black Country stations. Only small lots of Cleveland iron come into this district, and Continental foundry is too dear for local users. As regards special foundry irons, Scottish No. 3 is quoted at 85s., medium-phosphorus at 70s. to 80s., low-phosphorus iron at 80s. to 90s., and special refined iron at from £5 15s. to £6 15s., delivered this area.

SCOTLAND.—There is still little demand about for Scottish foundry iron, prices of which remain at the official minima, namely, 65s. for No. 3 foundry at furnaces, with 2s. 6d. extra for No. 1. Founders in the Falkirk area continue to be very busy, and they are pressing for supplies of English irons, prices of which are unchanged. No. 3 Cleveland is 62s. 3d. at Falkirk and 65s. 3d. at Glasgow, Northampfonshire iron being 1s. 3d. per ton below these figures.

Coke.

Conditions in the foundry-coke market show little alteration. In the South Staffordshire market best Durham coke continues to be quoted at 36s. to 38s., inferior grades at 35s. to 36s., Welsh coke at 31s. 6d. to 45s., and Scottish low-ash coke at from 38s. 6d. to 39s. per ton.

Steel.

Current business in the steel markets has fallen away, in accordance with the season of the year. Many consumers are already covered over the first quarter of 1934. The demand for semis has remained good, and the fact that the home producers are so heavily committed this year has enabled Continental material to recover a slight footing in the British market. Conditions in the finished-steel trade continue to improve, and the outlook for the New Year is distinctly encouraging.

Scrap.

The Cleveland scrap-iron market remains firm, supplies being limited. Heavy cast iron is at 47s. 6d. and machinery metal at 49s., with light cast iron a little stronger at 43s. 6d. per ton. There continues to be a good demand from the foundries in the Midlands, where machinery metal is offered at 52s. 6d. to 55s. delivered, and good heavy pipe and plate scrap at 50s. Clean light cast-iron scrap is scarce in this district, and quoted at about 42s. 6d. delivered. Quotations in Scotland average 51s. to 52s. 6d. for machinery metal, 47s. 6d. to 48s. for ordinary cast iron, and 42s. 6d. for light metal. In South Wales, heavy cast iron is in poor demand, and weaker in price at about 45s. per ton. Good cast-iron machinery scrap is in restricted demand at 47s. 6d. to 50s., while light cast iron is also quiet at 47s. 6d. to 50s.

Metals.

Copper.—The copper market has exhibited a rather firmer tendency during the past week, quotations showing a good increase. Consumption in this country is reported to be well maintained, and the recent stability of prices has encouraged consumers to make purchases. There has also been a fair amount of buying by dealers, in anticipation of a stronger market in the New Year. Conditions on the American market show little change. Negotiations are still continuing between the N.R.A. officials and the copper industry, with a view to putting the latter under a "code," but a definite agreement on the matter seems as far off as ever.

The week's prices have been as follow :—

Cash.—Thursday, £31 6s. 3d. to £31 7s. 6d.; Friday, £31 12s. 6d. to £31 13s. 9d.; Monday, £32 16s. 3d. to £32 17s. 6d.; Tuesday, £33 5s. to £33 6s. 3d.

Three Months.—Thursday, £31 8s. 9d. to £31 10s.; Friday, £31 13s. 9d. to £31 15s.; Monday, £32 17s. 6d. to £32 18s. 9d.; Tuesday, £33 7s. 6d. to £33 8s. 9d.

Tin.—The firmer tendency has stimulated a little more inquiry from consumers and a rather better business is reported both in this country and on the Continent, while more activity has obtained in the United States of America, where general conditions have shown more stability. The firmness may in a measure be attributed to the rather more favourable reports regarding the general situation in America: the industrial and trading position there is said to be improving and less apprehension seems to exist with regard to the political situation and the outcome of the efforts which are being made to restore more normal conditions, report Messrs. Rudolf Wolff.

Daily quotations :—

Cash.—Thursday, £228 5s. to £228 7s. 6d.; Friday, £228 5s. to £228 7s. 6d.; Monday, £228 10s. to £228 12s. 6d.; Tuesday, £228 to £228 2s. 6d.

Three Months.—Thursday, £228 7s. 6d. to £228 10s.; Friday, £228 5s. to £228 10s.; Monday, £228 10s. to £228 12s. 6d.; Tuesday, £228 to £228 2s. 6d.

Spelter.—The demand from consumers in this country is somewhat restricted, but nevertheless steady. The market showed a somewhat firmer tone following the more favourable reports with regard to the position of the International Zinc Cartel, to which we referred in our last issue. It is apparent that the Cartel has the situation well under control in its efforts to maintain a balance between supply and demand.

Price fluctuations :—

Ordinary. — Thursday, £14 15s.; Friday, £14 17s. 6d.; Monday, £14 18s. 9d.; Tuesday, £15 3s. 9d.

Lead.—The market has been steady and practically unchanged, although the trend has been rather more favourable. Covering purchases have been made by consumers in certain branches of the industry in this country, but, generally speaking, there has been a slowing down in most manufacturing lines. The figures which have been published in America for the month of October show an increase in stocks of nearly 9,000 short tons, which brings the total figure back almost to the level at which it stood at the beginning of the year. It is unsatisfactory to note that deliveries have fallen slightly during the month, whereas production has increased considerably. It is announced that the Mount Isa Mine in Australia will reopen after the holidays, state Messrs. Brandeis, Goldschmidt in their weekly report.

Daily market prices :—

Soft Foreign (Prompt).—Thursday, £11 12s. 6d.; Friday, £11 10s.; Monday, £11 10s.; Tuesday, £11 6s. 3d.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

34,509. POTTS, H. E. (Curtin-Howe Corporation). Production of protective coatings on iron and steel articles. 398,685.

6,439. VEREINIGTE STAHLWERKE AKT.-GES. Means relating to the production of cast steel. 398,740.

8,202. STONE & COMPANY, LIMITED, J., MURPHY, A. J., and ROSENHAIN, DR. W. Lining or coating of metal objects with dissimilar metals. 398,809.

10,956. DEHN, F. B. (Detroit Electric Furnace Company). Method of melting finely-divided scrap metal of the nature of borings and turnings. 399,569.

24,791. ELECTRO METALLURGICAL COMPANY. Alloy steel springs and spring blanks. 399,643.

11,007. SMALLWOOD, A., and FALLON, J. Furnaces and the like and the conveyance of goods therethrough. 400,185.

10,780. RUSS, E. F. Aluminium melting furnaces. 400,524.

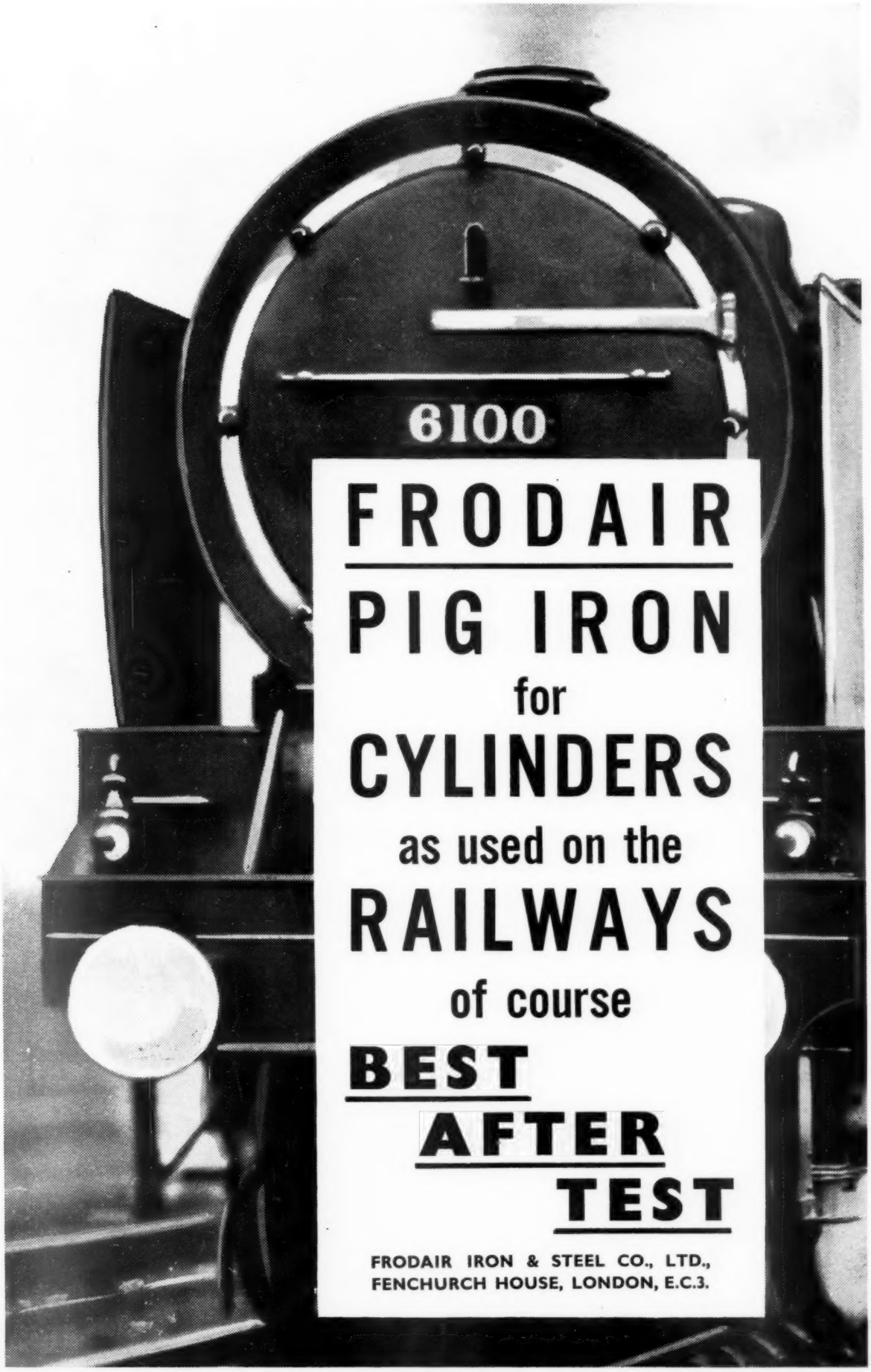
7,718. TRIGGS, W. W. (Davies, E. V.). Refining of iron and steel. 400,593.

Iron and Steel Output in November.

The National Federation of Iron and Steel Manufacturers state that there were 79 furnaces in blast at the end of November, an increase of five since the beginning of the month. Production of pig-iron in November amounted to 374,900 tons compared with 373,300 tons in October and 267,700 tons in November, 1932; the daily rate of operation thus showed an increase of nearly 4 per cent. between October and November. The production includes 102,400 tons of hematite, 178,300 tons of basic, 77,600 tons of foundry and 9,600 tons of forge pig-iron. The output of steel ingots and castings in November amounted to 695,000 tons compared with 668,300 tons in October and 473,800 tons in November, 1932.

Influence of Silicon on Pearlite.—The following are the conclusions contained in a Paper on "The Composition and Critical Temperature of Pearlite containing 1 per cent. Silicon," read by A. E. SCHOWALTER, W. W. DELAMMATTER and H. A. SCHWARTZ at a meeting of the American Society for Steel Treating held in Detroit. (1) The earlier observation that silicon lowers the carbon content of the eutectoid in the metastable iron-carbon system is not confirmed. (2) 1 per cent. of silicon appears to raise slightly the per cent. of carbon in the metastable eutectoid. (3) The apparent carbon content of the metastable iron-carbon eutectoid containing 1 per cent. silicon approximates 0.92 per cent. (4) The apparent carbon content of pearlite in alloys containing 1 per cent. silicon varies with the carbon content of the alloy, perhaps as an expression of changes in the relative silicon content of the austenite and ferrite. (5) 1 per cent. of silicon raises the A_1 transformation between 20 and 40 deg. C. The precise result probably depends upon the distribution of silicon between ferrite and austenite.

XUM


6100
FRODAIR
PIG IRON
for
CYLINDERS
as used on the
RAILWAYS
of course
BEST
AFTER
TEST
FRODAIR IRON & STEEL CO., LTD.,
FENCHURCH HOUSE, LONDON, E.C.3.

RAW MATERIALS—PRICE LIST.

(Tuesday, December 19, 1933.)

COPPER.

	£	s.	d.
Standard cash	33	5	0
Three months	33	7	6
Electrolytic	36	0	0
Tough	35	10	0
Best selected	36	0	0
Sheets	60	0	0
India	46	0	0
Wire bars	37	10	0
Ingot bars	37	10	0
H.C. wire rods	40	10	0
Off. av. cash, November	30	12	6
Do., 3 mths., November	30	15	3¾
Do., Sttlmnt., November	30	12	6
Do., Electro, November	34	6	4 4/11
Do., B.S., November	33	16	3
Do., wire bars, November	34	14	9 3/11
Solid drawn tubes			9¾d.
Brazed tubes			9¾d.
Wire			6½d.

BRASS.

Solid drawn tubes	8¾d.
Brazed tubes	10¾d.
Rods, drawn	8½d.
Rods, extd. or rlld.	4¼d.
Sheets to 10 w.g.	7⅜d.
Wire	7⅜d.
Rolled metal	6¼d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN.

	£	s.	d.
Standard cash	228	0	0
Three months	228	0	0
English	228	10	0
Bars	230	0	0
Straits	233	0	0
Australian (nom.)	—		
Eastern	231	2	6
Banca	232	0	0
Off. av. cash, November	226	16	3 1/23
Do., 3 mths., November	226	8	10 4/11
Do., Sttlmt., November	226	16	4 4/11

SPELTER.

	£	s.	d.
Ordinary	15	3	9
Remelted	14	15	0
Hard	12	15	0
Electro 99.9	17	7	6
English	15	17	6
India	14	15	0
Zinc dust	20	0	0
Zinc ashes	3	5	0
Off. aver., November	15	3	11 3/11
Aver. spot, November	15	0	11 13/23

LEAD.

	£	s.	d.
Soft foreign ppt.	11	6	3
Empire	11	10	0
English	12	15	0
Off. average, November	11	13	1 27/41
Average spot, November	11	10	8 19/23

ALUMINIUM.

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	25	10	0
Do., V.M. ex whse.	23	10	0
Rods	28	15	0

ANTIMONY.

English	37 10 0 to 40 0 0
Chinese, ex-whse.	26 10 0
Crude	20 0 0

QUICKSILVER.

Quicksilver	9 5 0 to 9 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	6 10 0
45/50%	12 10 0
75%	18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	2/6 lb.
Tungsten metal powder—	
98/99%	2/9 lb.
Ferro-chrome—	
2/4% car.	32 0 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome—	
Max. 2% car.	34 10 0
Max. 1% car.	35 12 6
Max. 0.70% car.	37 10 0
70%, carbon-free	10½d. lb.
Nickel—99.5/100%	£225 to £230
"F" nickel shot	£202 10 0
Ferro-cobalt, 98/99%	5/– lb.
Metallic chromium—	
96/98%	2/8 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel				2	10	0
Bundled steel and shrngs.	2	2	6 to	2	10	0
Mixed iron and steel	2	5	0 to	2	6	0
Heavy cast iron				2	5	0
Good machinery	2	7	6 to	2	10	0
Cleveland—						
Heavy steel	2	7	6 to	2	9	0
Steel turnings				1	11	6
Cast-iron borings				1	2	0
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	7	6 to	2	9	0
Midlands—						
Light cast-iron scrap	2	2	6 to	2	5	0
Heavy wrought iron				2	15	0
Steel turnings, f.o.r.				1	9	0
Scotland—						
Heavy steel	2	7	6 to	2	10	0
Ordinary cast iron	2	7	6 to	2	8	0
Engineers' turnings				1	17	0
Cast-iron borings	1	16	6 to	1	17	6
Wrought-iron piling				2	11	0
Heavy machinery	2	11	0 to	2	12	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	21	0	0
Brass	17	10	0
Lead (less usual draft)	10	10	0
Tea lead	7	10	0
Zinc	10	0	0
New aluminium cuttings	70	0	0
Braziery copper	22	0	0
Gunmetal	23	0	0
Hollow pewter	150	0	0
Shaped black pewter	105	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast (d/d Tees side area)—	
Foundry No. 1	65/–
Foundry No. 3	62/6
,, at Falkirk	62/3
,, at Glasgow	65/3
Foundry No. 4	61/6
Forge No. 4	61/6
Hematite No. 1, f.o.t.	63/–
Hematite M/Nos., f.o.t.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	69/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/–
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	62/–
,, No. 3 fdry.	66/–
Northants forge	58/6
,, fdry. No. 3	62/6
,, fdry. No. 1	65/6
Derbyshire forge	62/–
,, fdry. No. 3	66/–
,, fdry. No. 1	69/–
Scotland—	
Foundry No. 1	67/6
,, No. 3	65/–
Hem. M/Nos. d/d	66/–
Sheffield (d/d district)—	
Derby forge	59/6
,, fdry. No. 3	63/6
Lincs forge	59/6
,, fdry. No. 3	63/6
E.C. hematite	76/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	67/–
Staffs fdry. No. 3	67/–
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/–
Dalzell, No. 3 (special)	102/6 to 105/–
Glengarnock, No. 3	80/–
Clyde, No. 3	80/–
Monkland, No. 3	80/–
Summerlee, No. 3	80/–
Eglinton, No. 3	80/–
Gartsherrie, No. 3	80/–
Shotts, No. 3	80/–

FINISHED IRON AND STEEL.

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	0	0 to	9	15	0
Nut and bolt iron	6	17	6 to	7	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	15	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	5	0 to	8	10	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)	7	12	6 & up.			
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	0	0 to	12	5	0
Hoops (Staffs)	10	10	0 & up.			
Black sheets, 24g. (4-t. lots)				10	5	0
Galv. cor. shts. (,,)				12	15	0
Galv. flat shts. (,,)				13	5	0
Galv. fencing wire, 8g. plain				14	0	0
Billets, soft	5	10	0 to	5	15	0
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	10	0
Tin bars				5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10¾d.
Sheet to 10 w.g.	11¾d.
Wire	11¾d.
Rods	10¾d.
Tubes	14¾d.
Castings	12¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	19.26
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	13.50
Basic	18.89
Bessemer	19.76
Malleable	19.30
Grey forge	19.39
Ferro-mang. 80%, seaboard	82.00
O.-h. rails, h'y, at mill	36.37½
Billets	26.00
Sheet bars	26.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	1.89
Steel bars	1.75
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.60
Steel hoops	1.85
Sheets, black, No. 24	2.25
Sheets, galv., No. 24	2.85
Wire nails	2.35
Plain wire	2.20
Barbed wire, galv.	2.85
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	20/– to 25/–
,, furnace	17/– to 18/–
Durham foundry	21/– to 25/–
,, furnace	15/–
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	16/6 to 16/9
,,	28×20 ,,	33/– to 33/6
,,	20×10 ,,	24/– to 24/3
,,	18¾×14 ,,	17/3 to 17/6
C.W.	20×14 ,,	15/– to 15/3
,,	28×20 ,,	31/9 to 32/–
,,	20×10 ,,	22/3 to 22/6
,,	18¾×14 ,,	15/6 to 15/9

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	6	0	0 to	7	0	0
Bars-hammered, basis	16	0	0 to	16	10	0
Bars and nail-rods, rolled, basis	15	15	0 to	16	0	0
Blooms	10	0	0 to	12	0	0
Keg steel	30	0	0 to	31	0	0
Faggot steel	18	0	0 to	23	0	0
Bars and rods dead soft, st'l	10	0	0 to	12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.		
Dec.	14	..	31	6	3	inc.	11/3
,,	15	..	31	12	6	,,	6/3
,,	18	..	32	16	3	,,	23/9
,,	19	..	33	5	0	,,	8/9

Electrolytic Copper.

			£	s.	d.		
Dec.	14	..	34	5	0	inc.	15/-
,,	15	..	34	0	0	dec.	5/-
,,	18	..	35	10	0	inc.	30/-
,,	19	..	36	0	0	,,	10/-

Standard Tin (cash).

			£	s.	d.		
Dec.	14	..	228	5	0	dec.	15/-
,,	15	..	228	5	0	No change	
,,	18	..	228	10	0	inc.	5/-
,,	19	..	228	0	0	dec.	10/-

Tin (English ingots).

			£	s.	d.		
Dec.	14	..	228	15	0	dec.	15/-
,,	15	..	228	15	0	No change	
,,	18	..	229	0	0	inc.	5/-
,,	19	..	228	10	0	dec.	10/-

Spelter (ordinary).

			£	s.	d.		
Dec.	14	..	14	15	0	dec.	1/3
,,	15	..	14	17	6	inc.	2/6
,,	18	..	14	18	9	,,	1/3
,,	19	..	15	3	9	,,	5/-

Spelter (Electro, 99.9 per cent.).

			£	s.	d.		
Dec.	14	..	17	0	0	inc.	5/-
,,	15	..	16	17	6	dec.	2/6
,,	18	..	17	2	6	inc.	5/-
,,	19	..	17	7	6	,,	5/-

Zinc Sheets (English).

			£	s.	d.		
Dec.	14	..	25	10	0	No change	
,,	15	..	25	10	0	,,	,,
,,	18	..	25	10	0	,,	,,
,,	19	..	25	10	0	,,	,,

Lead (English).

			£	s.	d.		
Dec.	14	..	13	0	0	No change	
,,	15	..	13	0	0	,,	,,
,,	18	..	13	0	0	,,	,,
,,	19	..	12	15	0	dec.	5/-

AVERAGE MONTHLY PRICES OF STEEL SHIP ANGLES (NORTH OF ENGLAND).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	5 5 0	5 5 0	5 5 0	5 7 6	5 13 9	5 15 0	5 15 0	5 15 0	5 17 6	6 0 0	6 5 0	6 7 6	5 14 3
1899	6 10 0	6 12 6	6 15 0	6 15 0	6 17 6	6 17 6	7 0 0	7 0 0	7 5 0	7 5 0	7 12 6	7 15 0	7 0 5
1900	7 15 0	8 0 0	8 2 6	8 5 0	8 5 0	8 7 6	8 7 6	8 2 6	8 2 6	8 0 0	7 10 0	7 10 0	8 0 7½
1901	6 15 0	6 12 6	6 5 0	6 0 0	6 0 0	5 10 0	5 15 0	5 17 6	6 0 0	5 17 6	5 17 6	5 15 0	6 0 5
1902	5 12 6	5 10 0	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 11 8
1903	5 6 3	5 6 3	5 7 6	5 12 6	5 12 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 0 0	5 8 9
1904	5 0 0	4 17 6	5 2 6	5 5 0	5 5 0	5 5 0	5 5 0	5 5 0	5 0 0	5 0 0	5 0 0	5 5 0	5 2 6
1905	5 5 0	5 7 6	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 10 0	5 12 6	6 2 6	6 12 6	6 12 6	5 14 4½
1906	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	6 12 6	7 2 6	6 13 4
1907	6 17 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	6 12 6	6 12 6	6 12 6	7 0 5
1908	6 2 6	6 2 6	6 2 6	5 17 6	5 17 6	5 17 6	5 17 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 16 3
1909	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 7 6	5 9 7
1910	5 16 3	5 17 6	5 17 6	6 1 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 7 6	6 7 6	6 7 6	6 2 3½
1911	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 7 6	6 9 0	6 7 8½
1912	6 16 3	6 17 6	6 17 6	7 5 0	7 7 6	7 7 6	7 7 6	7 12 6	7 12 6	7 12 6	7 14 6	7 17 6	7 7 4½
1913	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 11 6	7 7 6	6 15 6	6 7 6	6 2 6	7 8 11½
1914	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	5 15 0	5 15 0	6 15 0	7 0 0	7 0 0	7 1 3	7 5 0	6 8 7½
1915	7 17 0	8 5 0	8 17 6	9 5 0	9 5 0	9 15 0	9 15 0	9 15 0	9 15 0	9 15 0	10 15 0	10 15 0	9 8 3½
1916	11 3 1½	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1917	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6
1918	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6	11 2 6½
1919	11 2 6	13 12 6	13 12 6	13 12 6	17 2 6	17 1 3	17 0 0	17 15 0	17 15 0	17 15 0	17 17 6	18 5 0	16 1 9
1920	19 10 0	20 0 0	21 10 0	22 0 0	23 5 0	24 0 0	24 0 0	24 0 0	24 15 0	24 10 0	24 0 0	24 0 0	22 19 2
1921	22 10 0	20 12 6	19 0 0	17 10 0	17 10 0	16 6 0	14 10 0	14 3 4	13 10 0	11 15 0	10 0 0	9 12 6	15 11 7
1922	9 17 6	10 0 0	10 0 0	10 0 0	10 0 0	9 17 6	9 10 0	8 15 7½	8 14 0	8 12 6	8 12 6	8 12 6	9 7 8½
1923	8 18 1½	9 1 3	9 14 0	10 0 0	10 0 0	10 0 0	9 8 9	9 9 6	9 10 0	9 8 9	9 11 6	9 18 9	9 11 8½
1924	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 2	9 11 3	9 15 0	9 15 0	9 9 4½	9 6 6	9 5 0	9 5 0	9 13 1½
1925	9 2 0	9 0 11½	9 0 0	8 15 9	8 10 3½	8 9 0½	8 6 3	8 2 6	7 19 0½	7 12 3	7 5 0	7 2 6	8 5 8½
1926	7 2 6	7 2 6	7 2 6	7 3 4	7 2 6	7 3 9	7 7 6	7 8 5½	7 9 0	7 12 6	7 16 3	8 0 6	7 7 7½
1927	7 18 9	7 17 6	7 17 6	7 14 8½	7 13 9	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 12 6	7 14 1½
1928	7 12 6	7 14 9	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 17 6	7 16 10½
1929	7 17 6	7 17 6	7 17 6	7 17 6	8 0 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 5 0	8 0 10½
1930	8 7 6	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1931	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1932	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6
1933	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

METALLURGICAL Chemist (29 years), experienced in many branches of iron and steel industry, including stainless, seeks position. Capable to take charge of analytical laboratory. Excellent testimonials from three previous employers.—Box 582, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ONE of the best-known Furnace and Foundry Equipment Salesmen, with extensive works experience, is open to receive offers of service from firms engaged in this line of business. Highest credentials available.—Box 1874, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WELDING Supervisor or Foreman required, with technical and practical training. Accustomed to welding various metals, but chiefly steel and cast iron. Must be able to teach and supervise operators.—Apply, stating age and experience in detail, also wages required, to Box 588, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

YOUNG Metallurgist, considerable experience foundry metallurgy and practical work, desires position as Metallurgist or Assistant Manager. Wide experience foundry mixings (iron and non-ferrous), purchase raw materials, sales, etc. (234)

YOUNG Foundry Foreman requires position. Experience on textile machinery, machine-tool and engine work; jobbing and repetition. Experience in cupola control, mixtures and sand control. (235)

MACHINERY.

18 IN. Cylinder Tabor Shockless Jolt Roll-over Moulding Machine, about 20-in. clear pattern draw, with table 60 in. by 48 in.; can be seen working. Cheap to clear.—Box 586, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THOS. W. WARD, LTD.

Pneumatic Sand MOULDING MACHINE, admits pattern boxes 16″ x 16″ x 6″.

Belt-driven BLOWER, 2 side inlets, each 10½″ x 6½″, outlet 10″ dia.

RUMBLER, 15′ long x 4′ dia. x ¼″ thick.

LANCS BOILERS, 30′ x 8′, 130 lbs. w.p.

46-n.h.p. Port. LOCO. BOILER, heating surface 749 sq. ft., grate surface 22 sq. ft., 125 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued.*

Tilghman Cast-iron Sand-blast Room. 12 ft. x 9 ft. x 8 ft. 3 in.
Tilghman T.B.1 Sand-blast Barrel Plant.
Tilghman T.B.3 Sand-blast Barrel Plant.
Tilghman Cabinet Plants, several sizes.

Send for List to
A. HAMMOND, 14, Australia Road, Slough.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

"STOCK" Oil-fired Steel Converter, ½-ton capacity, with all equipment, cheap to save removal. "Stock" Oil-fired Steel Converter, 1-ton capacity, with Blower and Equipment, cheap to save removal.

A. HAMMOND, 14, Australia Road, Slough.

"PAIRS."

Pair of 14-in. x 16 in. TABOR Split Pattern Squeezers.
Pair of 12-in. x 18-in. TABOR Split Pattern Squeezers.
Pair of 30-in. x 20-in. OSBORN Jolt Stripping Machines.
Pair of MACDONALD 30-in. x 20-in. Roll-over Machines.
Pair of 440-lb. M.R.V. Coke-fired Furnaces.
Pair of 25-ton Ladles (you *may* need ONE!).
Pair of ADAPTABLE Moulding Machines.
ABOVE *PAIRS* ALL *REPAIRED.*

A. HAMMOND, Foundryman, Slough 287.

MISCELLANEOUS.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264

30-ton "Collin" Crane Ladle.
25-ton Evans Crane Ladle.
20-ton Evans Crane Ladle.
15-ton Evans Crane Ladle.
12-ton Evans Crane Ladle.
10-ton Evans Crane Ladle.
Twenty smaller Ladles, mostly Evans.
All above in good, safe working order.

A. HAMMOND, 14, Australia Road, Slough.
'Phone 287.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. A new edition will be going to press soon. *Write now* for full particulars and advertisement rates.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

PNEUMATIC MACHINES

Two "Osborn" Jolt strip machines 32″ × 20″ £75 each.
Two "Tabor" 18″×36″ portable rollover jolters £60 each.
One "Tabor" 24″×48″ portable rollover jolter £90
30″×20″ Macdonald rollover jolter £60
20″×16″ Macdonald rollover jolter £40
8 Ton Macdonald plain jolter, 20″ cylinder ..£160

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 £30
Herbert "Whizzer" type disintegrator, No. 2 £46
Rotary sand mixer and elevator £24
Gyratory sand riddle with motor £7
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

COLBOND-ING

Now takes its place as standard practice in foundries where economy counts as much as quality and finish of castings.

You add it to your sand.

Particulars from:
COLBOND,
24, Martin Lane, Cannon St., London, E.C.4.
Telephone: Sloane 4862.

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(FOUNDED 1833)
SWISS COTTAGE, LONDON, N.W. 3